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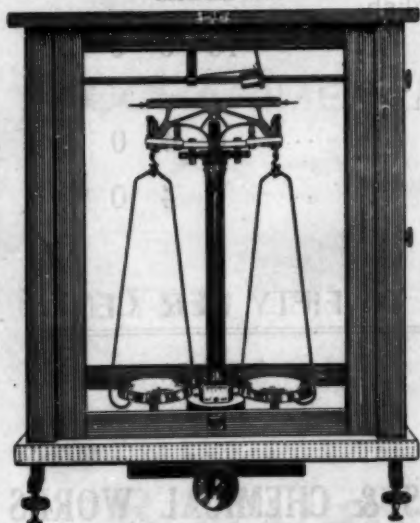
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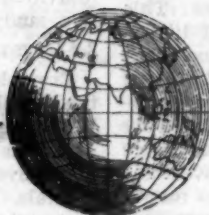


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THE INFRA-RED SPECTRUM*

1. INTRODUCTION

THE radiations whose wave-lengths are greater than those of visible light and less than those of the shortest radio-waves constitute the so-called "infra-red spectrum". They are of great interest in relation to several subjects, as for instance, astrophysics, meteorology, thermodynamics and chemistry, to mention no others. The experimental study of the infra-red spectrum presents peculiar difficulties. For the most part, the aid of photography which makes exact studies possible with other parts of the electromagnetic spectrum is not available here. Less satisfactory devices have, therefore, to be employed, which mostly depend on the thermal or heating effect of the rays. As indicated by the

Planck radiation formula, the energy of thermal radiation falls off rapidly with increasing wave-length. This makes it difficult to obtain sources of adequate strength for the larger wave-lengths and renders observation and measurement with such wave-lengths difficult and uncertain. A further problem is that of finding suitable materials for prisms which are transparent and have adequate dispersive power in the region under study. Absorption by water-vapour and by carbon dioxide in the atmosphere present other complications. The necessity of exploring the spectrum step by step also makes the work laborious and time-consuming. It is not surprising that in these circumstances our knowledge of the infra-red spectrum has progressed much less quickly than that of the visible or ultra-violet. That such difficulties have been surmounted and useful results obtained by the pioneers in the field is a tribute alike to

* Presidential Address delivered by Sir C. V. Raman, Kt., F.R.S., N.L., at the 13th Annual Session of the Indian Academy of Sciences, held at Cuttack, on the 26th December 1947.

their experimental skill and to their perseverance.

A quickened interest in infra-red spectroscopy is evident at the present time. This is shown by the increased output of literature and also by the several excellent treatises which have appeared of recent years dealing with the field. These developments have doubtless been stimulated by the knowledge which has become available to us since 1928 by spectroscopic investigations on the scattering of light. When monochromatic radiations traverse a transparent medium, the spectrum of the diffused light exhibits new lines, the frequency shifts of which with respect to the incident light represent the characteristic infra-red frequencies of the substance. This way of finding the infra-red frequencies enables us to enlist the powerful aid of photography, since the shifted lines appear in the visible or ultra-violet region of the spectrum; whether the frequency shifts are large or small, they are recorded and rendered accessible to study with the same facility. The insight and knowledge thus derived have proved a powerful stimulus to further study of the infra-red absorption spectra and furnished aid in the interpretation of the results. The infra-red frequencies determined by either method being those of the molecular vibrations in the substance, the two methods are complementary to each other, and also mutually helpful. Quite appropriately, therefore, the results of both methods of study are discussed together in the most recent texts dealing with this field.

It is worthwhile emphasising that studies of the molecular vibration spectra by infra-red absorption or by the scattering of light are not merely of academic interest. Indeed, they have proved to be powerful aids to industry in the chemical and other allied fields. Especially in dealing with organic chemicals are such physical methods more convenient and—with appropriate techniques—also quicker than purely chemical methods of identification or analysis. The vibration spectrum of a molecule is determined by the geometric configuration of the atoms in it, as well as by the atomic masses and the binding forces holding them together. In consequence, the characteristic features of molecular structure reveal themselves by the vibration frequencies, as also by the intensities with which they appear in

the infra-red spectra. Hence, the features of the observed vibration spectra are a powerful aid to the identification of the individual substances and to the quantitative analysis of mixtures.

2. CRYSTALS AND THE INFRA-RED SPECTRUM

Crystals have played a notable part in the development of infra-red spectroscopy. We have only to recall the fact that the materials which are or could be utilized as dispersive prisms in infra-red work are crystals. The optical behaviour of such materials in relation to their chemical nature and physical structure offers much food for thought. Taking, for instance, the case of rock-salt, the measurements of its refractive index which have been made in the region of wave-lengths between 1μ and 22μ indicate that the vibration frequencies which effectively determine its dispersion lie in the remote infra-red in the region of 60μ . We may well ask, why is it then that rock-salt begins to show an appreciable absorption at 12μ and exhibits a practically completely cut-off beyond 15.5μ making it useless as a material for prisms beyond that wave-length? Lithium fluoride again, which is another material which has lately come into use for infra-red work, has its effective "dispersion" frequency located at about 32μ . Nevertheless the material shows total opacity beyond 16μ . We are led to ask, what is the reason for such opacity?

Standing in close relation to the questions raised above, is the remarkable discovery made by Rubens and Nichols that a beam of infra-red radiation is monochromatised more or less perfectly if it undergoes a series of reflections at the surface of a crystal. This method of obtaining "residual rays" by crystal reflections has been extremely useful in infra-red studies, as it enables a strong beam of specified wave-length to be readily obtained. Various questions arise with regard to the principle of the method. What relation does the residual-ray wave-length bear to the infra-red frequencies which are effective in dispersion? What thickness of the material is needed to give the desired strength of reflection? What is the relationship between the reflecting power and the absorption coefficient for wave-lengths lying in the region of opacity?

It is evident that the answers to the questions raised above are closely related to the

fundamental problem of the nature of the vibration spectrum of a crystal and its activity in infra-red absorption. This, in its turn connects up with the question of the relationship between the atomic architecture of the crystal and its infra-red activity. The intimate nature of this relationship will be evident when we consider for instance, the striking difference in behaviour between, say, diamond and rock-salt. The infra-red activity of diamond is extremely weak, while that of rock-salt is extremely strong. Is this difference in behaviour due merely to the difference in the details of crystal architecture, or is it due to the difference

bit an absorption curve of the type shown in Fig. 1 in which there is a region of strong absorption between 700 cm^{-1} and 1500 cm^{-1} , while other diamonds (not so common) do not show the absorption in this region. All diamonds, however, show the absorption in the region of higher frequencies beyond 1500 cm^{-1} , and the features of such absorption do not show any noticeable differences as between different diamonds. The latter fact makes it clear that the strong absorption between 1500 cm^{-1} and 2900 cm^{-1} is a characteristic property of diamond. Why then is the absorption between 700 cm^{-1} and 1500 cm^{-1} present

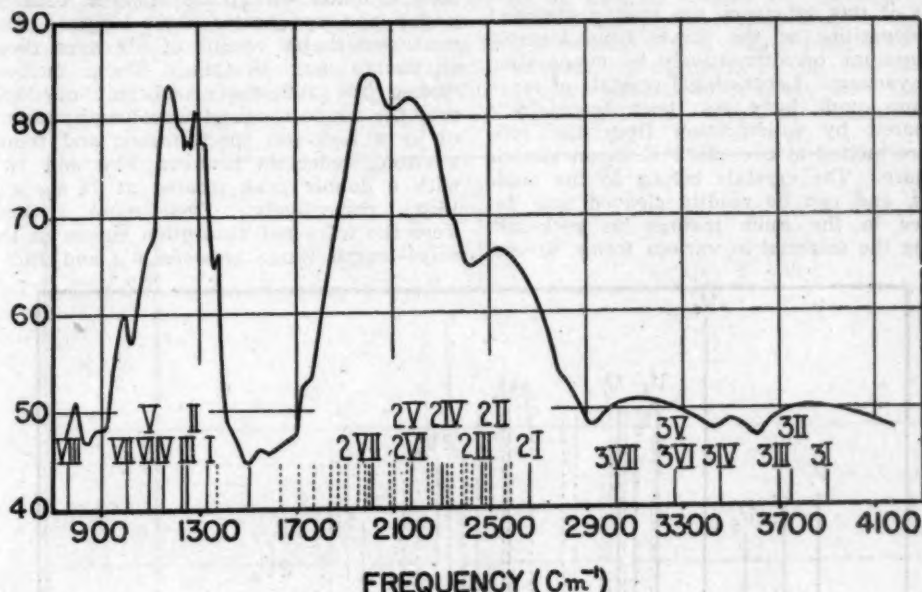


FIG. 1. Infra-Red Absorption Spectrum of Diamond
(after K. G. Ramanathan)

in the nature of the binding forces in the two cases?

The power of infra-red spectroscopy to throw light on the problems of crystal structure is strikingly exemplified in the case of diamond. As mentioned above, the infra-red activity of this crystal is weak, and a thickness of the order of one millimeter is needed to exhibit a readily measurable absorption. Remarkably enough, however, it has been found that the nature of the absorption curve is not the same in all diamonds. The majority of diamonds exhi-

bit an absorption curve of the type shown

in Fig. 1 in which there is a region of strong absorption between 700 cm^{-1} and 1500 cm^{-1} , while other diamonds (not so common) do not show the absorption in this region. All diamonds, however, show the absorption in the region of higher frequencies beyond 1500 cm^{-1} , and the features of such absorption do not show any noticeable differences as between different diamonds. The latter fact makes it clear that the strong absorption between 1500 cm^{-1} and 2900 cm^{-1} is a characteristic property of diamond. Why then is the absorption between 700 cm^{-1} and 1500 cm^{-1} present

a notable heterogeneity of structure. It follows that the appearance of the infra-red absorption with the diamonds exhibiting it cannot be ascribed to the presence of crystal imperfections, but must be referred to a fundamental difference in crystal symmetry between the two classes of diamonds, which results in an observable infra-red activity of the vibrations of the structure in one case and its inactivity in the other.

3. THE CASE OF MAGNESIUM OXIDE

We shall now proceed briefly to recount the facts which have come to light as the result of experimental studies on the infra-red behaviour of magnesium oxide. Thin films of this substance are readily obtained by deposition of the fumes from burning magnesium, or alternatively by evaporation in a vacuum. Large single crystals of magnesium oxide have also been successfully prepared by solidification from the substance melted at over 2500° C. in an electric furnace. The crystals belong to the cubic class, and can be readily cleaved into flat plates in the same manner as rock-salt. Using the material in various forms, several

spite of the simplicity of its structure which is similar to that of rock-salt, the crystal has a whole series of characteristic infra-red frequencies in the vicinity of which intense absorption and reflection are observed. Tolksdorf observed a strong absorption at 14.2 μ . Strong found practically complete absorption at 20.8 μ and at 22.9 μ . He also found that at these wave-lengths, the reflection coefficient was 80% and 72% respectively and fell off rapidly with larger wave-lengths. Fock found the most intense absorption at 17.3 μ which he regarded as characteristic of MgO, though his observations also gave indications of other absorption maxima both at longer and at shorter wave-lengths. The most remarkable results of all were those of Barnes and Brattain. These authors studied the reflection coefficient of MgO over the whole range of wavelengths covered by a rock-salt spectrometer, and found a strong reflection between 13 μ and 16 μ with a double peak located at 14.8 μ and 15.3 μ respectively. Even more striking were the infra-red absorption curves in the wave-length range between 6 μ and 15.5 μ

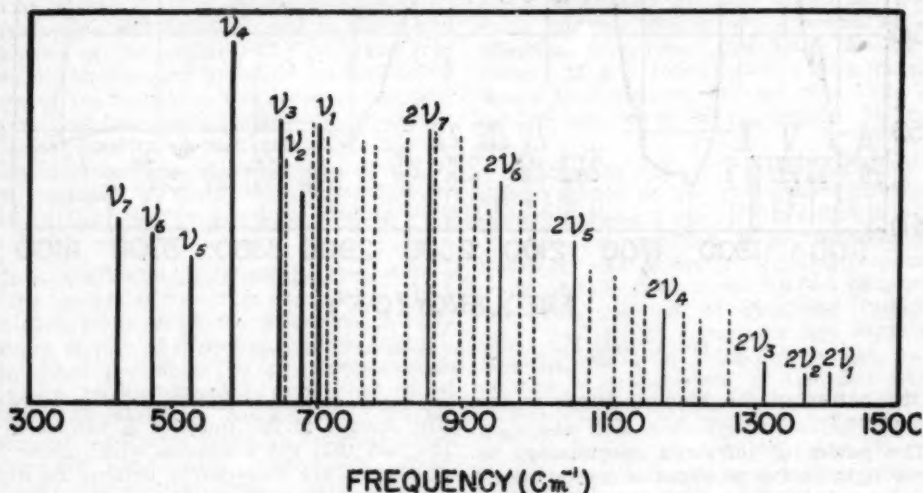


FIG. 2. Infra-Red Absorption Frequencies of Magnesium Oxide

investigators (Tolksdorf, 1928; Strong, recorded by them with five plates of various 1931; Fock, 1934; as also Barnes and thicknesses, ranging from the thinnest ob- Brattain, 1935) have investigated the attainable to very thick ones. The curves behaviour of the substance in respect exhibit no fewer than 40 well-defined ab- of infra-red absorption and reflection. The sorption lines in this range. results reported by these authors are The facts recited above are irreconcilable exceedingly remarkable, namely, that in with the ideas regarding the spectroscopic

behaviour of crystals derived from the lattice dynamics of Max Born as applied to various actual cases by Blackman, Kellermann and others. Since the structure of magnesium oxide is similar to that of rock-salt, the only mode of vibration of the structure which according to the theory of Born would be infra-red active is the so-called "fundamental vibration" of the lattices of magnesium and oxygen atoms against each other. There would, in addition, be an immense number of other modes of vibration which taken together would constitute a continuous spectrum of frequencies. Actually, the observations indicate that the vibration spectrum of magnesium oxide in the region of infra-red frequencies is not continuous but discrete, consisting of a set of sharply defined monochromatic frequencies, all of which are infra-red active in greater or less degree.

theories of the subject (Debye, Max Born) approach this from the standpoint of the classical theory of elasticity. They identify the vibrations in the solid with waves traversing its interior in all directions. Such an approach is legitimate in considering the vibrations of low frequency in respect of which the discrete atomic structure of the medium may be ignored and the medium treated as continuous. But in considering the behaviour of a crystal in the infra-red range of frequency, we have necessarily to take into account its discrete structure, and the experimental facts show that the identification of the atomic vibrations with waves of all possible lengths and directions filling the volume of the crystal is not a valid procedure, and that a different approach to the problem is necessary. The fact that the crystal consists of a great many units of very small size which are exactly similar

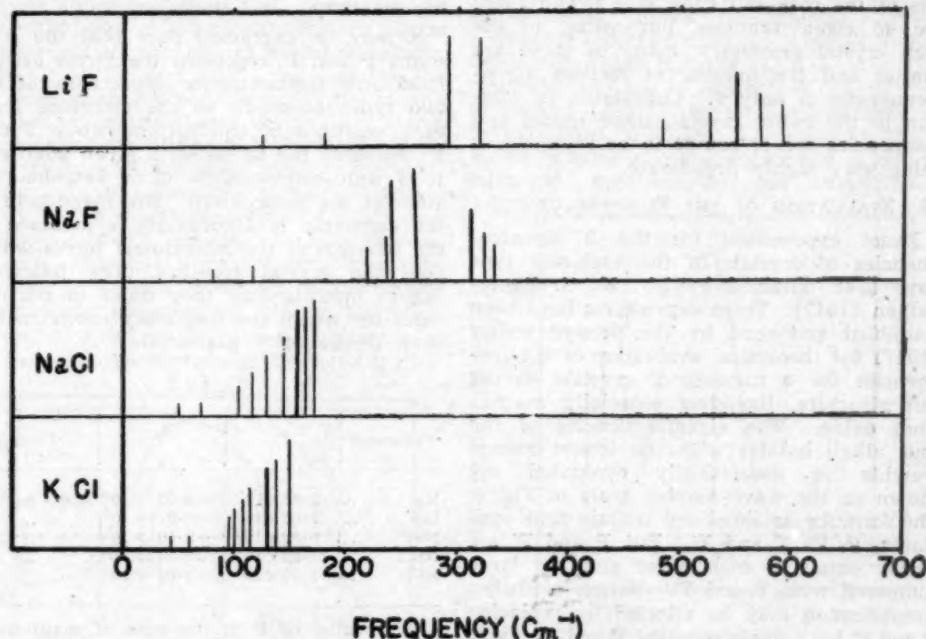


FIG. 3. Eigenfrequencies of Four Alkali Halides

4. THE EIGENVIBRATIONS OF CRYSTAL STRUCTURES

To find an explanation of the remarkable facts detailed above, we have to consider the fundamental problem of the nature of the vibration spectrum of a crystal. The older

and similarly situated is the very natural starting point for such an approach. Since further, the atomic forces which determine the modes and frequencies of vibration of these units of structure are of limited range, the problem of determining these modes and

frequencies is closely analogous to the theory of the vibrations of polyatomic molecules, except that the units of structure are not isolated from each other and hence it is necessary to consider also their interactions. The problem has been handled by the present writer from this point of view (1943, 1947) and the result is reached that the structure of a crystal containing p atoms per unit cell has $(24p - 3)$ characteristic eigenvibrations. In $(3p - 3)$ of these eigenvibrations, equivalent atoms in adjacent cells of the structure oscillate with the same amplitude and the same phase, while in the remaining $21p$ eigenvibrations they oscillate with the same amplitude but with a phase which alternates in successive cells along one, two or all axes of the crystal lattice. The maximum number of distinct eigenfrequencies is $(24p - 3)$, but this number may be considerably reduced by reason of the crystal symmetry in various actual cases. For crystals of the rock-salt type, $p = 2$, and there are 45 eigenvibrations, but owing to the high crystal symmetry, many of these are similar and the number of distinct eigenfrequencies is only 9. Considered in relation to the entire crystal, these modes and frequencies are of course to be regarded as being very highly degenerate.

5. EVALUATION OF THE EIGENFREQUENCIES

Exact expressions for the 9 eigenfrequencies of crystals of the rock-salt type have been obtained by Mr. K. G. Ramanathan (1947). These expressions have been simplified and used by the present writer (1947) for theoretical evaluation of the frequencies for a number of crystals having this structure, including especially magnesium oxide. The eigenfrequencies of the four alkali halides with the lowest atomic weights as theoretically evaluated are shown on the wave-number scale in Fig. 3. The formulæ as simplified contain four constants, P , P' , T and T' . But P and P' are nearly equal to each other and are large compared with T and T' . Hence, a further simplification may be effected by replacing P and P' by a single constant P and similarly also T and T' by a single constant T , being in each case their arithmetical mean. Even as thus highly simplified, the formulæ are sufficiently accurate to represent the facts correctly. For instance, in the case of magnesium oxide, the 9 eigenfrequencies expressed in wave-numbers come out as 704, 680, 652, 584, 527, 474, 428, 258 and

184 cm.^{-1} respectively. Expressed in infra-red wave-lengths, they are 14.2μ , 14.7μ , 15.35μ , 17.1μ , 19.0μ , 21.1μ , 23.4μ , 38.8μ and 54.4μ . The first three of the calculated eigenfrequencies (ν_1 , ν_2 , ν_3) are recorded in the observations of Barnes and Brattain made with their thinnest plate as strong and well-defined absorption maxima. ν_4 coincides with Fock's absorption maximum, while ν_6 and ν_7 are those noted by Strong. The octaves of the first seven eigenfrequencies are also represented in the data of Barnes and Brattain as prominent absorption maxima. Some twenty other absorption lines recorded by them are also satisfactorily accounted for as summations of the eigenfrequencies taken two at a time. In Fig. 2 above, the fundamental eigenfrequencies are shown by heavy lines, their octaves by thin lines, and the summational frequencies by dotted lines. ν_8 and ν_9 are less than 300 cm.^{-1} and do not therefore appear in the diagram.

It may be explained here that the constants P and P' represent the forces arising from unit displacements respectively of the two types of atoms in the structure from their positions of equilibrium, while T and T' represent the forces on a given atom due to a unit displacement of a neighbouring atom of the same kind. The magnitude of the constants is accordingly a measure of the strength of the interatomic forces which hold the crystal together. The following figures indicate how they differ in the five cases for which the frequency spectrum has been theoretically evaluated.

TABLE I

Substance	P	T	Units
MgO ..	2.82×10^5	-0.05×10^5	dynes per cm.
LiF ..	1.02×10^5	-0.015×10^5	"
NaF ..	6.72×10^4	-0.10×10^4	"
NaCl ..	2.422×10^4	-0.053×10^4	"
KCl ..	2.30×10^4	-0.05×10^4	"

The value of P in the case of magnesium oxide is of the same order of magnitude as the force-constants for covalent bindings known in various cases, and hence in spite of its structure being of the rock-salt type, magnesium oxide is very far indeed from being an "ionic" crystal. It may be mentioned for the sake of comparison that the force-constant P in the case of diamond is

31.4 μ and 34.2 μ . In other words, the strongest infra-red activity is *not* that of the mode in which the lithium atoms and the fluoride atom move as groups in opposite

phases, but of the modes in which the fluorine atoms alone oscillate, the lithium atoms retaining at rest.

Surprising as the foregoing results may seem, they are supported by the fact that analogous results are also exhibited by the other crystals, though in a less striking fashion. In the case of sodium fluoride, Barnes (1932) found the maximum absorption by thin films to be at 40.6μ , which is midway between 38.3μ and 41.8μ , the wave-lengths of ν_4 and ν_3 which are oscillations of the fluorine atoms with the sodium atoms remaining at rest. With magnesium oxide, the strongest absorption by thin films

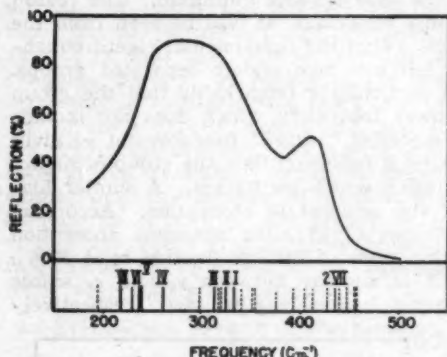


FIG. 6. Reflection Coefficients of Sodium Fluoride

as found by Fock is at 17.3μ , nearly coinciding with ν_4 which is an oscillation of the oxygen atoms against each other, the magnesium atoms remaining at rest. In the cases of NaCl and KCl, the maximum absorption by thin films does not coincide with ν_3 , but move nearly with ν_1 which is the highest of the nine eigenfrequencies, being an oscillation of the atomic layers parallel to the cubic planes, normally to themselves, with the metal and the halogen atoms which they contain moving in the same phase.

The fact which emerges clearly from the case of magnesium oxide is that all the eigenvibrations, as also their octaves and their summations, are infra-red active in greater or less measure. The measure of this activity is given by the absorption coefficient at the particular frequency. This

has been evaluated by Mr. K. G. Ramanathan from the published data of Barnes and Brattain (1935) and represented on a logarithmic scale of ordinates in Fig. 2. It will be seen that the absorption coefficient falls off rapidly as we move towards higher frequencies. This suggests that the infra-red activity of the various modes in MgO and in the alkali halides is essentially an induced effect, arising from mechanical anharmonicity and consequent coupling with

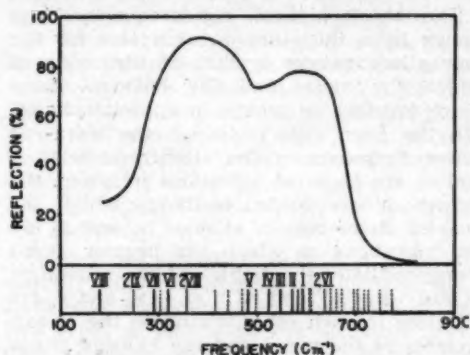


FIG. 7. Reflection Coefficients of Lithium Fluoride

each other of the various eigenvibrations, as a consequence of which all of them become active in greater or less measure, depending principally on their approximation in frequency to the "active" mode ν_3 . The activity of the various possible overtones and summations necessarily falls off as we pass successively from the first-order to the second-order spectrum and from the second-order spectrum to the third-order spectrum and so on, the successive limits of frequency of these spectra being set by the highest fundamental and its overtones. The large diminution in the absorption coefficient and consequent improvement in transparency as we move towards shorter wave-lengths is readily understood on this basis.

Fuller details regarding the various topics referred to above, as well as references to the cited literature will be found in papers by the writer appearing in the *Proceedings of the Indian Academy of Sciences* for December 1947.

C. V. RAMAN.

ONE HUNDRED YEARS OF ANÆSTHESIA

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ANÆSTHESIA has grown from a scientific curiosity in early nineteenth century to an indispensable weapon in the armoury of modern medicine. This article attempts to give a general account of the development of anæsthesia and anæsthetics during the last hundred years. From the most remote periods, surgeons have sought the means to relieve the pain of operations. The internal administration of drugs seems to have been the time-honoured method. In China Indian hemp was used for this purpose. The stupor produced by compressing carotids and thereby producing anæsthesia with the aid of carbon dioxide was employed by the Assyrians, and hypnotism was practised in the East. In later times advantage was taken of the intoxication produced by alcohol. However, the discovery of the means to achieve complete and safe anæsthesia is an accomplishment of the 19th century (1842-1847). The credit of the discovery must be divided among several investigators: Sir Humphrey Davy for his brilliant researches on the chemistry and pharmacology of nitrous oxide, and for suggesting the possibility of using it as a means of anæsthetising patients during surgical operations; C. W. Long for discovery of the anæsthetic properties of ether; Horace Wells for application of nitrous oxide as an anæsthetic; C. T. Jackson and Morton for successful demonstration of the use of ether as a surgical anæsthetic, and Flourens and Sir James Simpson for the introduction of chloroform.

After the discovery of chloroform no major advance was made in general anæsthetics, until about 1923. Since then active researches have recommenced. Ethylene, cyclopropane, evipal and some thio-barbiturates have been introduced, and a wide variety of methods on basal narcosis have been investigated.

MECHANISM OF ACTION OF ANÆSTHETICS

During the last decade or two, anæsthesia has encroached more and more upon the domains of organic and physical chemistry as well as of physiology and biochemistry. In the days gone by, anæsthesia was accepted as such, and no explanation was sought for its action, but now nothing is taken for granted. It has been realised that until some insight is gained into the mysteries of consciousness, our appreciation of the phenomena of anæsthesia will remain inadequate. Strictly speaking anæsthesia means loss of sensation. But the drugs which cause a general loss of sensation also cause loss of consciousness, and this is their most obvious effect. Anæsthesia may be produced in several ways: (1) by temporary paralysis of the sensory nerve endings in the immediate neighbourhood of the part to be operated on (local analgesia), (2) by temporary suspension of the conductivity of the main nerve trunk supplying the affected area (spinal or regional analgesia). But by neither of these methods the patient is rendered un-

conscious as is the case with (3) administration of a volatile substance through inhalation or (4) by injecting certain substances into the rectum, veins, etc.

Several theories have been advanced, and they are all concerned with the explanation of changes in the nerve impulse and with consciousness. Anæsthesia resembles sleep in many ways, and many of the theories of sleep may with slight modification explain anæsthesia as well. The most important of these are (1) the accumulation of waste products, (2) consumption of intramolecular oxygen, (3) toxin theories, (4) the neuron theory and (5) the anæmic theory. In all these theories it is assumed that there is either a depression of the irritability of the brain cells or the exclusion of stimuli from the periphery or both. Anæsthetic activity is responsible for both of these conditions. The "Mayer-Overton Theory" assumes that anæsthetics act by their solubility in the lipoids of the nerve tissue with consequent fall in conductivity and irritability of the nerve. "The theory of Moore and Roaf" accepts the lipid solubility but states that the anæsthetic dissolved in lipid is rendered inactive. According to this view anæsthesia is caused by a loose combination of ether, chloroform, etc., with the protoplasm of the brain cells. The lipid material, however, absorbs and holds the anæsthetic in contact with the protein and in this way aids the production of anæsthesia. "Verworn's theory" accepts the Mayer-Overton theory to the extent that it explains how the anæsthetic reaches the field of action; but this view holds that real action is due to depression of the activity of the cerebral cells through reduction of their power to carry on oxidation.

MODERN ANÆSTHETICS

The constant increase in the complexity and severity of surgical operations has demanded more and more from anæsthesia, and many of the surgical procedures carried out at the present time require a very high degree of technical skill.

The choice of anæsthetics is a complex problem and is determined particularly by the condition of the patient and the type of operation. Safety is the first consideration, but the depth and duration of anæsthesia, the comfort of the patient and the convenience of the operator are also important.

The several agents that are now in use will be very briefly dealt with, and only certain salient features touched upon. Those that deserve consideration are general anæsthetics, e.g., ether, chloroform, ethyl chloride, vinyl ether, trichlor-ethylene, nitrous oxide, ethylene, avertin with or without morphine and scopolamine and barbiturates, spinal anæsthetics and local analgesics.

The merits and demerits of the volatile anæsthetics are well known and need not be

elaborated here. Suffice it to say that chloroform has been found to be far more dangerous than ether or nitrous oxide, although in the hands of the expert, the acute dangers may be greatly reduced. The chief immediate risks are the induction period. The danger of post-anæsthetic toxæmia makes its employment in prolonged operation almost inexcusable. Ether and nitrous oxide are practically safe in ordinary cases, but nitrous oxide is perhaps the safest form for short operations and in sequence to ether.

A large variety of volatile soluble hydrocarbons has anæsthetic properties and many of them have been studied pharmacologically and clinically. Those that have achieved some practical prominence may be mentioned. *Ethylene* has been used extensively in America, and most observers claim that it possesses many advantages over ether or nitrous oxide. The rapid action and recovery, however, demand close attention on the part of the anaesthetist.

Cyclopropane or trimethylene has been found of great advantage in thoracic surgery although recently it has been largely replaced by kemithal. The supporters of cyclopropane claim that it produces fewer toxic effects than other powerful anaesthetics. It has been used clinically with good results in a considerable number of cases, especially in Wisconsin and Montreal. *Venyl ether* is unreliable in the production of full muscular relaxation, but is largely used for small operations of short duration.

It is well known that the introduction of halogen atoms increases the anæsthetic properties and toxicity of aliphatic narcotics. Mention may be made of ethylchloride, trichlorethylene, and avertin (tribromethanol). The utility of *Ethylchloride* as a general anaesthetic is mainly limited by its extremely volatile nature. Anaesthesia is induced very rapidly, and recovery is equally rapid. It is, therefore, particularly suited for minor operations. The main use of ethylchloride is for local anaesthesia—by freezing the tissue with a fine spray of the liquid. The impossibility of dissecting the frozen tissues restricts its use to simple incisions (opening boils and abscesses). The analgesia is imperfect, and thawing painful.

Trichlorethylene is now generally recognised to have a definite place in anaesthesia in spite of certain disadvantages. It has been given extensive trial, but is probably not a desirable agent for general anaesthesia. It acts as a prompt central analgesic and is used (self-inhaled, using a simple "Draw over" apparatus such as Freedman's) to relieve the pain of trigeminal neuralgia. Muscular relaxation is very poor. It should not be used to produce deep anaesthesia. For light anaesthesia, used as an adjuvant to nitrous oxide, it is probably quite safe. It is very useful in minor surgery and dental practice where surgical anaesthesia is unnecessary or undesirable. Trichlorethylene analgesia is also tending to replace nitrous oxide and air in midwifery in many parts of Britain.

Tribromethanol was introduced under the name "avertin" as a fixed-dose anaesthesia for

rectal administration to produce rather evanescent surgical anaesthesia. Reports regarding the safety of avertin are conflicting. It was originally recommended for use as a full anaesthetic, but it is now considered to be dangerous in doses needed to produce this effect. It is used, at present, as a basal narcotic, full narcosis being produced by the administration of nitrous oxide and oxygen.¹

Many of the derivatives of barbituric acid have been used in medicine for years as hypnotics and sedatives. Since the central effects do not differ in principle from those of the other aliphatic narcotics, certain of the rapidly acting barbiturates can be used alone or in combination to produce true general anaesthesia. The chief difference lies in the non-volatility. They cannot, of course, be administered by inhalation but by mouth, rectum, hypodermically or intravenously. The non-volatility also entails a more prolonged and continuous action. This secures steadiness but restricts flexibility. The latter is a distinct disadvantage, as the anaesthetist can do nothing to lighten the effects if they are too severe. The duration of anaesthesia is also another disadvantage. The use of barbiturates as the chief agents of anaesthesia has, therefore, been considered to be unjustified, although those with relatively brief action are employed in special techniques. Barbiturates in conjunction with inhalation anaesthesia are a definite accession to anaesthetic technique. They are now generally administered to induce sound sleep on the night prior to operation to soothe the patient, and remove nervousness and to secure smooth induction and finally to contribute to the action of the anaesthetic itself.

The common barbiturates that are used to produce general anaesthesia are sodium evipan, pentothal and kemithal. The choice of preparation involves chiefly the duration of effects, the toxicity and the personal experience of the anaesthetist with the drug.

Evipan (cyclohexanyl methyl barbiturate of sodium) was introduced especially for intravenous anaesthesia. It acts very quickly and is rapidly broken down in the body. In a good number of cases death has occurred by depression, and it must be used with great discrimination. The chief objection to its use is that it is liable to produce clonic twitching. It may be used with fair safety, however, in a relatively narrow field of analgesia. The action of thio-barbiturates is generally similar, but much shorter.

Thiopentone (pentothal) has largely replaced evipan. This drug is used to produce prompt unconsciousness with rapid recovery so that the depth of anaesthesia may be fairly controlled, an advantage over evipan. But, nevertheless, it is dangerous and should not be used indiscriminately. This drug is not well suited for long operations. Obstetric analgesia has been reported to be fairly good with pentothal; excitement is absent and no harmful effects have been observed in the mother or child.

A new thio-barbiturate "Kemithal" (5-cyclohexanyl-5-allyl-2-thio-barbituric acid) has recently been introduced. It has been given a

fair trial, and the results have so far been very satisfactory. Carrington and Raventos have carried out pharmacological investigations and consider it to be half as potent as thiopentone, and slightly less potent than hexobarbitone; but owing to its lower toxicity kemithal has a wide margin of safety. Equi-active doses of these drugs produce a similar duration of action and onset of anaesthesia. Clinical experience supports the experimental findings.² Kemithal has been used as an anaesthetic agent in a number of cases. It has been used for induction before cyclopropane anaesthesia, as the principal anaesthetic agent in combination with nitrous oxide and oxygen; as a sole anaesthetic agent with or without oxygen, and to produce hypnosis in association with regional anaesthesia. The results have been satisfactory—post-operative recovery is rapid and is marked by the absence of complications. This drug has been found to have a particular advantage when anaesthesia has to be prolonged. It is especially indicated in thoracic surgery. In such operations there is usually a diminished vital capacity, and anaesthesia in any form tends to cause further embarrassment. There are many other problems too which the anaesthetist has to face. No real advancement towards the solution of these problems had been made till recently when cyclopropane with oxygen anaesthesia was introduced. But long continued use of cyclopropane has its disadvantages. Trials with thiopentone did not prove satisfactory. Kemithal has recently been used on a number of cases of major thoracic operations, and it has been noted that the drug has distinctly many advantages over other barbiturates. There is no respiratory depression and laryngeal spasms are absent. Recovery is very rapid, and there are no post-anaesthetic complications. This technique is undoubtedly a big step forward in the field of anaesthesia. The use of d-turbocurarine chloride along with Kemithal has been very promising.

Attempts to blend the actions of volatile anaesthetics by mixing them have been unsuccessful mainly because the ingredients do not volatilise with equal rapidity. The composition of the inspired anaesthetic is, therefore, quite uncertain. A more rational method of combining the advantages of different anaesthetics is to employ them in sequence. Thus anaesthesia may be induced by the pleasant and promptly acting nitrous oxide and then continued with ether. These may be preceded by a sedative dose of morphine or a full hypnotic dose of a barbiturate, to produce basal narcosis. This probably presents the nearest approach to an ideal anaesthesia.

Many recent advances have been made regarding administration of general anaesthetics. Most inhalation anaesthetics are given with nitrous-oxide-oxygen-ether apparatus. The flow of the gases is regulated and mea-

sured fairly accurately by flow-meter (the Rotameter is the present favourite). The Nuffield Department of Anaesthetics has produced a device, the Oxford vaporiser, which is calibrated to deliver known proportions of ether vapour up to 25 per cent. The ether is kept at a constant temperature over a water-bath. A brief pictorial survey of the evolution of anaesthetic apparatuses by A. Charles King is given in the *British Medical Bulletin* (Vol. 4, No. 2, 1946). This is very instructive and gives a clear idea of the advancement in the technique of administration of various anaesthetics.

Side by side with the advancement of general anaesthesia, there has been a revival of interest in local and regional anaesthesia. Mushin⁴ has described the bilateral vagal nerve block at its point of emergence from the skull, for such operations as laryngotomy. For upper abdominal surgery, bilateral intercostal nerve block, combined with light general anaesthesia or extradural caudal block has been found especially valuable.

Spinal anaesthesia has been less frequently used during recent years. Nupercaine is the drug of choice, but amethocaine and procaine have also been used.

No reliable statistics of anaesthetic mortality are available. The existing figures give only a rough idea of the relative danger. According to the various compilations, the acute mortality for chloroform is given as 1 in 1,000 to 1 in 5,900, a fair estimate would seem to be 1 in 3,500. This does not take into consideration the delayed deaths. For ether, the figures are 1 in 5,100, to 1 in 23,200—the average would be perhaps 1 in 16,000; for ethyl chloride, 1 in 3,000 to 1 in 7,000; for nitrous oxide in short operations less than 1 in 5,000,000. Beecher (1938) gives 1 in 2,000 for avertin and for chloroform, 1 in 3,500 for cyclopropane, 1 in 5,000 for ether and 1 in 50,000 for nitrous oxide.⁵

With the development of the art and science of anaesthesia operations which were once few in number, have greatly multiplied. At the present day, with our advanced knowledge and experience and constant dependence on the various agents at our disposal, it is difficult to understand how surgical practice could have been conducted without them. Anaesthesia has enabled the surgeon to attack almost every region of the body, and, instead of the operation being hurried over as in the pre-anaesthetic period, the surgeon can now undertake to carry on with deliberation and accuracy. The recent advancement in the field of anaesthesia has been a definite boon to mankind.

1. Hewer, *Brit. Med. Bull.*, 1946, 4, 2, 108.
2. Mainintosh and Scott, *Lancet*, 1916, 1, 767.
3. Halton, *Ibid.* 1946 1, 771.
4. Mushin, *Proc. Roy. Soc. Med.*, 1946, 38, 308.
5. Sollmann, *Manual of Pharmacology*, 1942.

VARIATION OF SURFACE TENSION OF SOLUTIONS WITH TIME*

LORD RAYLEIGH observed that the surface tension of sodium oleate and saponine solutions showed large differences according as whether a static or a dynamic method was employed for the determination. The dynamic (vibrating jet) method measured the tension of a surface hardly a fraction of a second old, whereas the static (capillary rise) method measured the tension of an aged surface. The study of this phenomenon was followed up by a number of investigators later, employing mainly the capillary rise, drop weight and ring methods. The results revealed that the surface tension of solutions of many dyestuffs, proteins, soaps and related substances changed considerably with time. Several theories were put forth to explain the phenomenon. Though in some cases chemical interaction with the atmosphere undoubtedly complicated the phenomenon,² it was surmised by many workers that the variation was due to the slowness with which the adsorption film was developed at the surface of solutions.³

EXPERIMENTAL DEMONSTRATION OF SLOW ACCUMULATION

An important advance was made by the application of the Langmuir-Adam film balance for the study of this phenomenon by the present author and his collaborators. It was well known that the film balance could give differential values of tensions of the surfaces on the two sides of the float. It was, therefore, convenient to compare the tension of a fresh surface with that of an old one since one of the sides of the float could be kept fresh by sweeping. Further this technique had the advantage that it involved the least disturbance (even the sessile bubble and sessile drop methods would involve large changes in the extent of the interface due to changes in the shape of the bubble or drop) and that the contact angle effects were non-existent. The results obtained⁴ with solutions of benzopurpurine 6 B proved to be reproducible. During the course of the study, the existence of a large amount of "impurity" covering a considerable fraction of the total aging surface was noticed. The "impurity" was later identified to be the adsorption film of the dye which behaved like the insoluble monolayers studied by Langmann and Adam. *This novel phenomenon formed the first experimental demonstration of the progressive accumulation of the solute molecules to form the adsorption film.*

THE HYPOTHESIS OF ACTIVATED ACCUMULATION

By assuming plausible values for the area of cross-section of the dye molecule, it was possible to calculate the actual rate of accumulation of the dye at the surface. This observed rate was smaller by several orders than the collision frequency of the dye molecules against the surface. The gas-kinetic equa-

tion was used for calculating the collision frequency and the applicability of this equation to solutions was justified by the author on the basis of Wheeler's theory of liquid state.⁵ The hypothesis of activated accumulation was put forth to explain the slow accumulation. This hypothesis could also explain the high temperature coefficient of accumulation, exhibition of surface pressure and variation of surface tension with time.

Working with solutions of purified Benzopurpurine 10 B, it was established by crucial experiments and theoretical reasoning that the observed formation of the surface film was not due to (a) any change in the bulk accumulation of the solution, (b) any reaction with air and (c) any insoluble impurity from the solution or the atmosphere accumulating at the surface. Moreover, it was shown by sweeping aged and fresh surfaces that the surface got enriched with the dye molecules with time.⁶ It was further shown that the hypothesis of Donnan and Barker,³ (slow diffusion due to the high molecular weight of the solute) was unable to account for the phenomenon; for, to account for the slowness, it would be necessary to assume fabulous values for the diameter of the molecule. The hypothesis of Milner,⁷ based on large surface excess was again untenable, since the covering up of even half the available surface took considerable time. The hypothesis of polymerisation⁸ would not account for the phenomenon; for, it would need the assumption that (i) the equilibrium between the monomers and polymers should be frozen in bulk, (ii) the rarer species should be adsorbed to a greater extent and (iii) the accumulating species would behave like an insoluble impurity. It was thus obvious that the only comprehensive hypothesis which could account for the slowness of accumulation was the hypothesis of activated accumulation. It had to be noted however that this hypothesis was only a generalised description of conditions at the interface. The exact cause of the activation energy requirements for the accumulation process, was yet to be investigated.

THE ELECTRICAL POTENTIAL BARRIER

During a detailed investigation⁹ of the time-area curve for the accumulation of benzopurpurine 10 B, it was found that the accumulation slowed down with time much more than could be accounted for, on the basis of the free area available for accumulation. It appeared that electrical repulsion effects might be responsible for the phenomenon. Calculation¹⁰ was made on the assumption that the first lot of dye ions accumulating at the interface form a charged surface which would repel similarly charged ions. A diffuse double layer would thus be formed and would hinder the accumulation of the dye molecules at the surface in the same way. This effect, however, would be considerable almost from the commencement of accumulation if the surface film was gaseous. The only hindrance to accumulation was due to this type of poten-

* Text of Sir Subrahmanya Iyer Endowment Lectures delivered by Dr. K. S. Gururaja Rao, Imperial Institute of Sugar Technology, Cawnpore, on 12th and 13th Dec. 1947, at Presidency College, Madras.

tial barrier; the system would show a tremendously high initial rate of accumulation followed by a very slow accumulation for a considerable length of time. A very similar feature would be exhibited in the variation of surface tension with time as well. Though this hypothesis did not account for the behaviour of benzopurpurine, it accounted very well for the observations made by Adam and Schute¹¹ with cetyl pyridinium bromide and other solutions. These systems exhibited gaseous surface films which showed a tremendously high initial fall of surface tension slowing down considerably after some time. There appeared to be little doubt that the diffuse electric double layer was the main cause for the behaviour exhibited by the systems studied by Adam and Schute. Another example of this was given by solutions of Nekal Bx.¹² Though the slowness of accumulation observed right from the start with benzopurpurine 10 B cannot be accounted for, on the basis of the electric potential barrier, the latter can explain condensed type) the slowing down of accumulation at later stages.

THE CASE OF BENZOPURPURINE 10 B AND SIMILAR SYSTEMS

The activation energy for the accumulation of benzopurpurine 10 B, remained a mystery for a long time. It may appear at first sight that the dye molecule would orient itself so as to put the hydrophobic portions projecting out from water and the hydrophilic groups dipping in water. It occurred to the present author¹³ that such an orientation with numerous hydrophilic groups dipping in water would have a high solubilising influence and would render such a molecule unstable at the interface. If, however, one or more of the numerous hydrophilic groups in the dye molecule could be pushed out of water, the solubilising influence would be diminished. These groups may, moreover, help in lateral binding of the accumulated molecules by dipolar or ionic lattice forces. The stabilisation of a molecule of the dye would, therefore, consist in a simultaneous release of the required number of hydrophilic groups from the water surface. While this was a plausible interpretation of the activation requirements for the accumulation process, even a rough calculation of the rate of accumulation would involve the knowledge of the vibration frequency of the water-hydrophilic group bond and the strength of the bond. These data are not available. This difficulty was, however, circumvented by the postulate, that due to the high attraction between the hydrophilic group and the water molecule, the process of detachment of the hydrophilic groups from the water surface takes place by the fissure (not of the hydrophilic group-water bond) of the water-water bond. The stabilisation of a dyemolecule was brought about by a simultaneous release of the water molecules attached to some of the hydrophilic groups (n) present in the dye molecule by a process akin to the evaporation process. On the basis of these postulates, and applying Wheeler's theory, the following results were ob-

tained for a M/4000 solution of Benzopurpurine 10 B:—

n	Theoretical rate of accumulation. (No. of molecules per sq. cm. per sec.)
0	10^{22}
1	10^{17}
2	10^{12}
3	10^7
4	10^2

The experimental rate of accumulation comes out to be 1.6×10^{11} molecules/sq. cm./sec. It appears from this calculation that two of the hydrophilic groups in the dye molecule are projected above the surface of water. Even the approximate correspondence between the theoretical ($n=2$) and experimental rates of accumulation may be taken to support the postulates made in the calculation. Though it is considered plausible that the two hydrophilic groups may be the amino and the sulphonate, further investigations would be needed to establish this conclusively. In this connection, it is of interest to note that other dyes such as Benzopurpurine 6 B and congorubin¹⁴ which have a similar structure also give similar results. It is of great interest to study the effect of protecting one or more of the hydrophilic groups of the dye in the study of the accumulation process.

SLOW ACCUMULATION DUE TO SLOW DIFFUSION

The investigations on casein¹⁵ and albumin¹⁶ solutions by the trough technique have revealed that the rate of accumulation is nearly of the same order as would be the case if the accumulation occurred by simple Brownian displacements. In these cases, therefore, it may be expected that concentrated solutions should show quick equilibrium. But it is found that the surface tension goes on changing with time for long intervals even with concentrated solutions. This phenomenon is due to (a) time required for orientation of the molecules in the adsorption film (the molecules being huge and complicated in structure would take a long time to get the final orientation which involves often an unfolding of the normal globular molecule so as to project out the hydrophilic groups), and (b) slow and progressive penetration by addition of molecules from below so as to render the film progressively more compact. It is to be pointed out that these two effects may also come into play in the case of benzopurpurine 10 B and in the systems studied by Adam and Schute only at the last stages of the accumulation process.

CONCLUSION

It is of interest to note that the application of Langmuir-Adam trough for the study of solutions was described by McBain and Wilson¹⁷ independently though a little later than the present author. But, the failure by Adam¹⁸ to obtain results of value may now be seen to be due to the following complications of the systems (such as acetylpyridinium bromide solutions) dealt with by him: (i) The solution gave rise to a gaseous film and made it difficult to measure the rate of accumulation, (ii) the solution was a good detergent and hence wet-

ted the barriers and edges of the trough; owing to this and the highly mobile nature of the gaseous adsorption film, the leakage, past the barriers occurred frequently and produced spurious results and (iii) the detergent being cationic got adsorbed on glass. These complications, however, do not occur with benzopurpurine 10 B. The great possibilities of the trough method have been appreciated by Gong-nell as can be seen from his statement:⁹ "The most interesting results obtained by McBain and his associates, Doss and Yerehikowsky and Akulinina explicitly point to the fact that this domain of surface chemistry has been unduly neglected and that one may expect to discover many unusual facts and reach surprising conclusions in the process of investigation of ordinary solutions."

The theoretical ideas put forth by the present author have been corroborated by some later workers.²⁰ Exception has been taken by Alexander²¹ who is, however, under the impression that the electrical potential barrier is postulated to explain all cases of variation of surface tension with time. But the comprehensive explanation put forth by the present author which appears to apply to most known cases is the hypothesis of activated accumulation. The electrical potential barrier is a particular case of the above hypothesis and is applicable only to systems such as those employed by Adam and Schute.¹¹ Alexander's criticism of the electric potential barrier is not valid on account of the following considerations:—

(a) Alexander has stated that the electrical potential barrier does not explain the elimination of the time effect at the water-oil interface. It is to be noted, however, that very few water-oil systems have been investigated so far. There are some water-oil systems in which the interfacial tension does vary with time.²² If such systems are investigated in detail, the role of the oil in the elimination of the time effect may become clear. Alexander's idea that the presence of non-polar molecules at the surface increases the rate of accumulation is not always true, since an opposite result is obtained when amyl alcohol is added to benzopurpurine 10 B solutions.²³

(b) Alexander has discussed the effect of monolayers on the rate of accumulation. But the data he has cited in this connection are too complicated to be of much use in testing the hypothesis. Alexander has not taken into consideration in his discussion the following factors: (a) the removal of the potential barrier, (b) the removal of the molecules of the monolayer by peptisation (peptising action is due to the amphipathic solute), (c) the nature of the interaction between the solute and the monolayer molecules and its effect on the rate of escape of the adsorbed solute into the solution, and (d) the contraction of the surface during the spreading of the piston oil. The conclusion of Alexander that "the use of suitable piston oil monolayers might be made the basis of a more general method for obtaining the final surface tension of solutions of ionised compounds", cannot be taken for granted.

(c) Alexander has further pointed out that the electrical potential barrier cannot explain the behaviour of hydrocinnamic acid solution in water or of lauryl sulphonic acid in isobutylene. But, in these cases, a different type of potential barrier is in existence. Obviously, the electrical influences are negligible.

(d) Alexander tries to compute the possible magnitude of the potential barrier by examining the reaction between ethyl palmitate monolayer and N.NaOH. He concludes that a factor of 4, and not much more, can be accounted for by the electrical repulsion. It is to be pointed out, however, that Alexander's procedure is not accurate since he has generalised the results obtained from a solution at high ionic strength (normal alkali) to all solutions. Any solution containing electrolytes to the extent of 1 N cannot be expected to exhibit large electrical repulsion effects. No data of the type examined by Alexander with solutions of low ionic strength are however, available.

(e) Alexander postulates that penetration and reorientation explains all the observed results. The author does not take exception to these ideas, though it may be pointed out that many of the cases examined so far exhibit activated accumulation and a few of them are associated with an electrical potential barrier. Alexander's assumptions that penetration and orientation are favoured by a hydrocarbon environment is not true as a general effect since amyl alcohol actually slows down the rate of accumulation of benzopurpurine 10 B.²³ His idea that "Na hexadecyl sulphate is adsorbed some ten times more slowly than the dodecyl compound" is not correct. To obtain a surface tension of 50 dynes/cm., it takes 5 minutes for the hexadecyl compound and 25 minutes for the dodecyl compound. Whereas this is difficult to understand on the basis of reorientation, the electrical potential barrier gives a simple explanation.

(f) We may further point out that the penetration idea of Alexander cannot apply to the initial stages of accumulation of benzopurpurine 10 B at all, since the accumulation is slow right from the start.^{10,23} The high temperature coefficient of the rate of accumulation is again incompatible with any simple penetration idea and is in support of the activation hypothesis.²³

(g) Alexander next goes on to explain the quick attainment of equilibrium in solutions known to contain micelles. He takes the analogy from the spreading of oleic acid on a surface covered by a piston oil and suggests that the rapidity of accumulation may be due to a similar spreading of the micelles at the surface. It is to be pointed out, however, that even if the above mechanism be accepted, the rate of covering up of the surface by the adsorption film is lowered by micelle formation since the number of micelles per unit volume for any given concentration of the solute is inversely proportional to the number of simple molecules present in each polymer and the rate of diffusion of the polymer is smaller than that of the simple molecule. If only classical infusion comes into effect, micelle formation

should bring down the rate of accumulation. So, Alexander's interpretation of this fact is incorrect.

(h) Though an exact molecular kinetic interpretation of the effect of micelle formation of the rate of accumulation is beset with difficulties, general considerations show that micelle formation should be associated with quick accumulation. It is to be pointed out that micelle formation is due to inter-molecular attractive forces, and it is hindered by inter-ionic repulsion. Inter-ionic repulsion between like ions is also the cause of the electrical potential barrier. Any factor which brings down the inter-ionic repulsion (e.g., addition of salts, increase of the concentration of the paraffin-chain salt) favours micelle formation and at the same time favours quick accumulation at interfaces. Thus the accelerating effect of salts is not due to micelle formation though the latter may take place incidentally. The increase in the rate of accumulation at higher temperatures (though the micelles themselves tend to break down at higher temperatures) is again a point against considering micelle formation as being the cause of quick accumulation.

(k) It may be finally pointed out that the penetration and orientation effects are also likely to consist of steps requiring energy of activation.

Thus the application of the film balance to the study of solutions has given a new and powerful tool in the hands of the physical

chemist. The study has already led to a comprehensive hypothesis for explaining the aging of surface and an extensive investigation in this field is further likely to be valuable in elucidating the several obscure phenomena associated with the surfaces of solutions of capillary active substances.

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DETAILS ABOUT ICE-AGE MAN

THE fossil remains of the 15,000-year-old Tepexpan man are being reassembled at the Smithsonian Institute in U.S.A.

Study thus far shows that this gentleman of the ice age was taller than his modern-day descendants. He is believed to have been about five feet eight inches in height—"well above the average stature of modern Mexican Indians".

The Tepexpan man, believed to be the oldest fossil human being, was dug up last February from an ice-age swamp near the village of Tepexpan, which is not far from Mexico City.

The remains—parts of a skull, jaw bones, arms, legs and a few other odd skeletal pieces—were flown to U.S.A. late in June. They are being reassembled by Dr. Stewart and Dr. Javier Romero of the Mexican National Museum of Anthropology.

Dr. Stewart emphasised that no final conclusions can be drawn since only one Tepexpan man has been found—and he may have

towered above his compatriots. He hopes another of his kind will be found to shed further light on this angle.

The Tepexpan's teeth were also interesting. Although worn down badly, there are no signs of dental cavities or tooth decay and many of his teeth were missing.

His brain appears to have been "about normal" for the modern Indian. His intelligence is also said to have been about the same.

According to the sutures of the skull Tepexpan was in his forties when he met death. It is assumed that he met an unhappy end, since his remains were found face down on what was once the edge of a lake. He may have been killed, but there is nothing now to account for his death.

As for Tepexpan's missing backbone, ribs, shoulder blades and pelvis, they evidently were either destroyed by animals or disintegrated through the years.

CONFERENCE ON CULTURE COLLECTIONS OF MICRO-ORGANISMS IN LONDON

A SPECIALISTS' Conference on Culture Collections of micro-organisms was held at the London School of Hygiene and Tropical Medicine between August 5th and 8th, 1947, and was attended by delegates from the United Kingdom, Australia, Canada, Eire, New Zealand, South Africa and the British Colonies. Suitable delegates from India were not able to be present, and it is with the object of informing Indian microbiologists of the recommendations made by the Conference that this article has been written.

The establishment of the "British Commonwealth Collections of Micro-organisms" was recommended as the first step to co-ordinate the activities of existing culture collection and to encourage the formation of new ones. A permanent committee is to be formed with its secretariat in London; each Dominion will be represented on the Committee, and overseas members will, where necessary, appoint deputies resident in England to attend meetings of the Committee.

National Committees are to be set up in each Dominion to carry out within their own countries the same co-ordinating work that the Permanent Committee does for the Commonwealth as a whole. It is desirable that members of these Committees should be scientists responsible for the day-to-day administration of the collections since many of the problems to be worked out will be technical. National or regional collections should be maintained and, where necessary, new ones developed to fulfil new needs. Collections may be required to supply organisms for one or more of the following purposes: teaching, both academic and applied research, and industrial processes. The Conference discussed at some length the advisability of having separate collections to serve different interests (agriculture, medicine, industry) but it was finally agreed that such a division was not desirable and that wherever possible a taxonomic classification should be used for separating the activities of collections so that one collection will maintain bacteria, another fungi, a third algae, and so on. This will have the advantage that workers in a collection need be trained only in one branch of microbiology, and in this branch they will become more expert than workers who have to deal with several branches.

Culture collections should not be an end in themselves, they should be the means to an end. They constitute a wealth of material for research of all kinds; therefore the qualified staff should consist essentially of research workers enlisted for their drive and ability rather than their knowledge of taxonomic relationships which they will pick up quickly when working in a collection. Collections should be centred at research or teaching institutes and the widest possible contacts should be maintained with research workers outside the collections; in this way it may be possible to delegate the maintenance of certain groups of organisms to specialists so that the cultures sent out will carry the authority of recognised experts.

The National and Permanent Committees will assist collections by distributing technical information, especially that relating to the preservation of micro-organisms.

The compilation of catalogues of different collections will be encouraged by the National Committee and, with the object of preparing a Commonwealth Catalogue in loose-leaf form, a uniform page-size is to be adopted (the actual size will be decided by the Permanent Committee). Recommendations were made about the details to be included in the catalogue of bacteria and fungi. To make the collections better known to workers a directory of Commonwealth culture collections is to be prepared, and this will give information about the kind of micro-organisms maintained in each collection.

When a culture is sent to a collection it should be accompanied by a detailed description and a reprint of any published work on it. Acceptance of a culture is left to the discretion of the curator who will see that the culture received conforms to the description sent. If the donor is not sufficiently interested to prepare an adequate description it is unlikely that the organisms will be of value to a collection.

The framework of the British Commonwealth Collections of Micro-organisms Organisation is sufficiently flexible to allow changes to be made as they may be needed. What the Conference did was to provide a nucleus; it is up to the Permanent and National Committees, supported by the collections, to develop the plan; by hard work and active co-operation it can be made the greatest Collection of Collections.

ATMOSPHERE ON MARS

HARVARD Observatory has announced that the first definite clue to the composition of Mars' atmosphere has been uncovered.

The amount of carbon dioxide is similar or greater than that found on earth, it was disclosed in a report from Director C. P. Kuiper of McDonald Observatory.

"It is quite a very important result," said Doctor Fred Whipple, Harvard Professor of Astronomy, "it means that, at last, we have some definite identification of the Martian atmosphere. All we knew before was that the

atmosphere on Mars contained a small amount of moisture."

The discovery was made possible by the wartime development of an infra-red photocell, a sort of superscope. With this device, Kuiper reported that an infra-red spectrum of Mars was recorded at McDonald Observatory and the carbon dioxide "found to be present in an amount similar to that on earth". Because of the pressure effects on the band intensity, he said, the carbon dioxide content of Mars' atmosphere will actually be somewhat larger than that of the earth, if the total pressure on Mars is less than on earth, as is

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LOWER LEVEL WINDS ALONG THE DELTAS OF THE NORTH MADRAS COAST IN THE MONSOON

WHEN the pilot balloon observatory was started at Masulipatam in 1942, it filled a gap between the observations at Madras and at Vizagpatam on the east coast of India. Soon after, it was noticed that the actual wind speed at lower levels of 0.5 and 1.0 km. at Masulipatam was much greater than at corresponding levels either at Madras or Vizagpatam. An application of the equation of continuity was attempted. The weather along the north Madras coast is free from precipitation except when a monsoon 'pulse' is passing over the place. At other times the upward velocity can be assumed to be negligible: Only the horizontal velocities need be considered. The modifications in the latter can only be due to orography (see figure).

Masulipatam is on the northern side of the Krishna delta and within 30 miles of the southern stream of the Godavari delta. The two deltas almost overlap. Taking account of the 1000 ft. contour, the Godavari valley is almost N.W. to S.E.; and the Krishna valley (north of the Nallamalai Hills) is almost W. to E. At a station situated on the overlapping portion of the deltas of Godavari and Krishna, the winds flowing down the two valleys must blow together or coalesce. The directive effect of the orography persists up to twice or thrice the height of the valley from the sea level (or up to about 3,000 ft. or 1.0 km. above sea level).

Above this height, there would be very little influence.



The west to east stream in the monsoon on the north Coromandel coast is the monsoon air mixed with other air while the northwesterly is

the dry continental air that goes to form the monsoon depressions. The latter air is well pronounced over the more extreme portions of the north Madras coast. The nearest pilot balloon observatory which can give the values of the W. to E. stream south of Masulipatam is Madras. The nearest observatory north of Masulipatam giving an idea of N.W. to S.E. stream is Vizagpatam. The distance between these latter observatories is great from Masulipatam. The values of wind speed and direction can only be approximations to those flowing along the valleys. The following table gives the average wind for the months of July and August for the three years 1942-45.

TABLE
Average Upper Winds in Mid-Monsoon

Height above	Madras		Vizag- patam		Masuli- patam		Madras + Vizag	
M.S.L.	D	V	D	V	D	V	D	V
0.5 km.	..	265 6.1	250 7.0	270 11.0	260 12.9			
1.0 km.	..	275 7.3	270 7.2	280 12.9	270 14.4			
1.5 km.	..	280 9.1	285 8.9	285 12.3	285 18.2			
2.0 km.	..	280 10.6	285 9.8	285 11.8	285 10.5			

D is the direction to the nearest 5°, and V speed (metres/sec.). The addition of wind velocity is vectorial.

It is seen that the algebraic sum of winds at Madras and at Vizagpatam are nearly of the same order but greater than at Masulipatam at 0.5 and 1.0 kms. At higher levels there is little comparison. It is surprising that such a good fit at the lower levels could be found considering the various uncertainties that enter meteorological quantities. If the winds at Masulipatam had exceeded the algebraic sum of the winds at Madras and at Vizagpatam at lower levels, the idea of applying the equation of continuity would necessarily have been open to question. It is not often that such simple applications are met with in weather.

During the other months, when the winds do not blow along the valleys of the rivers, e.g., in the N.E. monsoon, there is no abnormality in the winds at Masulipatam.

Poona 5,
November 19, 1947.

S. L. MALURKAR.

THE ESTIMATION OF THALLIUM

NUMEROUS volumetric methods have been proposed, which makes use of the reaction $Tl^{+} \rightarrow Tl^{+++}$. Most of the common oxidising agents have been tried and reported to yield useful results: Potassium permanganate,¹ Potassium bromate² and Ceric sulphate.³ While a considerable saving in time may be effected, these cannot be regarded as very satisfactory; for, the normal potential of the $Tl^{+} \rightleftharpoons Tl^{+++}$ system is about +1.2 v., and an indicator which will function under these conditions is hard to find. The use of irreversible indicators like methyl orange sometimes leads to faulty end-points, or one has to take recourse to complicated potentiometric methods. A rapid gravi-

metric method will, therefore, prove of some interest and the following procedure is believed to serve the purpose.

Procedure.—To the cold thallous solution containing not more than 0.2 gr. of the metal per 50 ml. are added with stirring 20 ml. of a 5 per cent. solution of iodic acid and 10 ml. of alcohol. The heavy white granular precipitate which comes down immediately is allowed to settle for a couple of minutes, filtered through a Jena glass filter of porosity 4, washed preliminarily with a mixture of equal volumes of 1 per cent. iodic acid and alcohol and finally with 50 per cent. alcohol, dried at 105°–110°C. and weighed as $TlIO_3$ factor for thallium = 0.67836.

Results.—A standard solution was made by converting 8.0973 gm. of pure thallium metal into the sulphate and making up the solution to 1 litre. Aliquots of this solution, either directly or on proper dilution, were pipetted out, for each determination. Simultaneously, estimations of thallium were carried out employing the chromate method of Moser and Brukl.⁴ The measuring flasks and pipettes used were those tested and certified by the National Physical Laboratory as conforming to A grade accuracy; these were further calibrated in this laboratory. Some of the results are detailed below.

Thallium taken (gm.)	Amount found in estimation as iodate (gm.)			Amount found in estimation as chromate (gm.)
	Minimum	Maximum	Average*	
0.2024	0.2004	0.2038	0.2020	0.2017
0.1619	0.1610	0.1620	0.1615	0.1618
0.0506	0.0498	0.0508	0.0503	0.0507
0.3219	0.3230	0.3241	0.3238	0.3236
0.4049	0.4041	0.4052	0.4048	..

* Represents the average of 5 estimations.

It will be noticed that at lower concentrations of the thallous ion the iodate values are slightly lower. This possibly arises from a slight solubility of the iodate precipitate. According to LaMer and Goldman⁵ the solubility of thallous iodate in water at 25°C. is about 0.7 gm. per litre, but under the above conditions of precipitation, the salt is almost insoluble. Further study of this aspect of the problem is in progress.

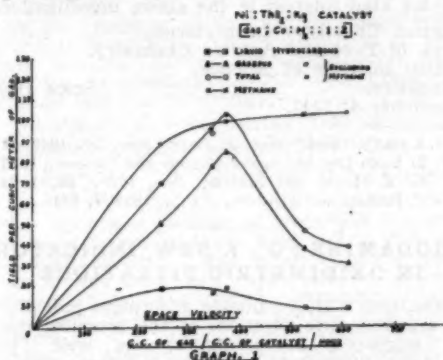
Andhra University,
Waltair,
October 28, 1947.

BR. S. V. RAGHAVA RAO.

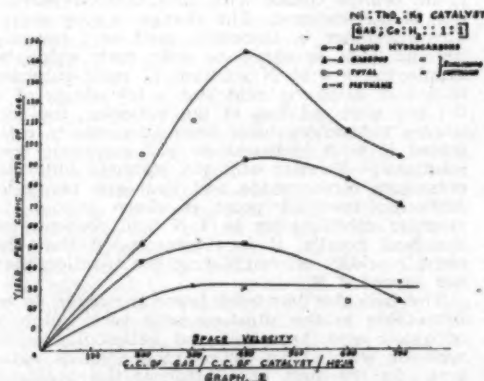
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NI-THO₂-KIESELGUHR (100:18:100) CATALYST FOR THE FISCHER-TROPSCH SYNTHESIS AT MEDIUM PRESSURE **PART III**

It is well known that there are certain advantages in operating Fischer-Tropsch synthesis at medium pressure. A. J. Underwood¹ and C. C. Hall² have shown that the operating pressure (5-15 atms.) has an effect on the yield of hydrocarbons and increases the life of the catalyst. The use of medium pressure enables one to reduce the size of the plant. The medium pressure process is modified by Ruhrchemie, A. G. (1939), using the cobalt catalyst and gives a product containing a high proportion of olefines by using straight water gas.



The present investigation is undertaken to improve the Fischer-Tropsch Synthesis of hydro-



carbons economically by using the (1) cheaper catalyst, (2) medium pressure and (3) water gas instead of synthesis gas. The use of cheap Ni-catalyst promoted by Thoria and supported by Kieselguhr at atmospheric pressure has already been reported by Ghosh, Basak and Badami.³

The same catalyst has been tried at 70 lbs./sq. inch pressure using synthesis as well as

water gas. It is observed that the best reaction takes place at 205° C. in both the cases and the catalyst has been found to be very steady. When synthesis gas is used the yield of methane is found to be very high as shown in the graph. But with water gas the yield of methane goes down and there is a corresponding increase of gaseous and liquid hydrocarbons. The yields of hydrocarbons are plotted against space velocities, using synthesis gas (Graph 1) and using water gas (Graph 2).

J. C. GHOSH.
N. G. BASAK.
C. VENKATESAN.

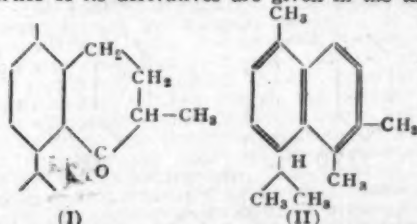
Dept. of Pure & Applied Chemistry,
General Chemistry Section,
Indian Institute of Science,
Bangalore,
November 1, 1947.

- 1 Underwood, A. J., *Ind. Eng. Chem.*, 1940, **32**, 449.
- 2 Hall, C. C., *J. of Inst. of Fuel.*, 1947 **20**, 63.
- 3 Ghosh, Basak and Badami, *Curr. Sci.*, 1947, **16**, 318.

STUDIES IN SESQUITERPENES **PART II. SYNTHESIS OF METHYL CADALENES**

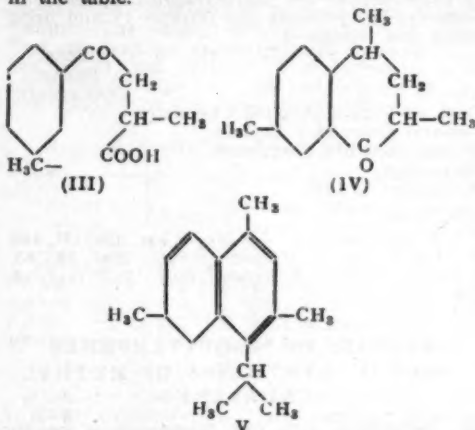
In connection with our investigations on the sesquiterpenes of the cadinene group it became necessary to know the properties of all the possible methyl-cadalenenes. In this advance communication we report the syntheses of the 5-methyl-, 8-methyl, and 3-methyl-cadalenenes. The other two had been prepared previously by Campbell and Soffer.¹

5-Methyl-cadalenene. 2, 5-Dimethyl-8-isopropyl-tetralone-1 (I) prepared from p-cymen² was treated with methyl magnesium iodide to give a mixture of the carbinol and its dehydration product. The mixture was completely dehydrated with 95 per cent. formic acid giving 1, 5, 6-trimethyl-4-isopropyl-7:8-dihydronaphthalene. Dehydrogenation of this hydrocarbon with selenium gave the required 1, 5, 6-trimethyl-4-isopropyl naphthalene (II). The properties of its derivatives are given in the table.

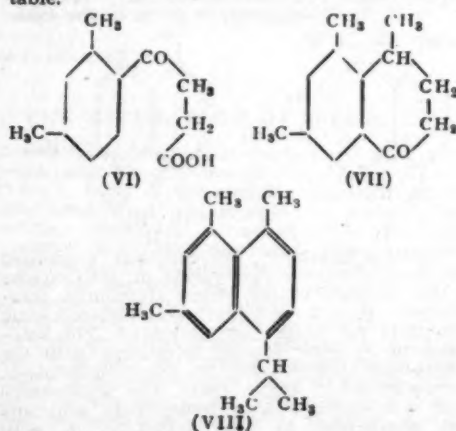


3-Methyl-cadalenene. Toluene was condensed with methyl succinic anhydride in nitrobenzene in the presence of anhydrous aluminium chloride to give β-(p-tolyl)-α-methyl-propionic acid (III) (cf. Mayer and Stamm).³ The keto-group of its ester reacted selectively with the magnesium methyl iodide to give γ-(p-tolyl)-γ, α-dimethyl-vinyl acetic acid. The unsaturated acid was reduced with hydro-iodic acid and red phosphorus to give γ-(p-tolyl)-γ, α-di-

methyl-butyrac acid. This acid was cyclised by anhydrous aluminium chloride and the tetralone (IV) so obtained reacted with magnesium isopropyl bromide to yield the unstable carbinol. The alcohol on dehydration followed by dehydrogenation with selenium furnished 1, 3, 6-trimethyl-4-isopropyl-naphthalene (V). The melting points of its derivatives are recorded in the table.



8-Methyl-cadalene. β -(2, m-xylol)-propionic acid (VI)⁴ was prepared by the action of succinic anhydride on m-xylene in the presence of anhydrous aluminium chloride. Its methyl ester on treatment with magnesium methyl iodide gave γ -(2-m-xylol)- γ -methyl-vinyl-acetic acid which was reduced to the corresponding butyric acid with hydro-iodic acid and red phosphorus. The acid on ring closure yielded the 4, 5, 7-trimethyl-tetralone-1 (VII). The ketone was treated with magnesium isopropyl bromide, when an unstable carbinol was obtained; the latter was dehydrated with 90 per cent. formic acid and then dehydrogenated with sulphur to give the 8-methyl cadalene (VIII). The melting points of its derivatives are given in the table.



Hydro-carbon	Picrate m.p.	Styphate m.p.	T. N. B. compound m.p.	T. N. B. compound m.p.
3-Methyl- cadalene	162-3°	..	165°	..
5-Methyl- cadalene	102.5-103.5°	130-1°	160-1°	87-8°
8-Methyl- cadalene	108-108.5°	..	118-118.5°	..

The full paper on the subject will be published elsewhere.

My thanks are due to Prof. P. C. Guha for his kind interest in the above investigation.

Organic Chemistry Laboratories,
Dept. of Pure and Applied Chemistry,
Indian Institute of Science,
Bangalore,
November 4, 1947.

SUKH DEV.

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RHODAMINE 6 G.-A NEW INDICATOR IN OXIDIMETRIC TITRATIONS

RHODAMINE 6 G, a valuable adsorption indicator, in argentometric titrations of the bromide, may be employed in oxidimetry as well. Its strongly fluorescent aqueous solution retains this property in dilute mineral acids (4 N), and is oxidised irreversibly by potassium permanganate, and reversibly by ceric sulphate to an orange colour with simultaneous extinction of fluorescence. The change is very sharp. This substance is, therefore, used as a reversible indicator in titrations with ceric sulphate. Employing a 0.05 N solution of ceric sulphate in 1.5 N sulphuric acid and a few drops of a 0.1 per cent. solution of the indicator, the following substances have been successfully estimated in both hydrochloric and sulphuric acid solutions:—Ferrous sulphate, stannous chloride, potassium ferrocyanide and hydrogen peroxide. Although the end point is sharp enough in stronger solutions up to 4 N acid content, for the best results, it is recommended that the overall acidity on completing the titration may not exceed 2 N.

The indicator has been found, however, to be unsuitable in the titration with ceric sulphate of oxalic acid, arsenious and antimonious acids, with or without an iodine monochloride catalyst. In the first two instances the indicator is rapidly destroyed, while in the case of antimonious acid, the formation of pentavalent antimony turns the indicator pink which undergoes no further change in colour even with a large excess of the oxidising agent. The subject is under further investigation. The indicator cannot be used in the presence of a precipitate or mercuric chloride.

It has further been observed that ferrous iron may be conveniently titrated with ceric

sulphate in the presence of oxalic acid or arsenious acid using this indicator. It would be interesting to recall the observations of Pound¹ who arrived at similar conclusions regarding the effect of various reducing acids on the titration of ferrous sulphate using a different method of indication. Fuller details will appear elsewhere.

Andhra University,
Waltair,
November 14, 1947.

BH. S. V. RAGHAVA RAO.

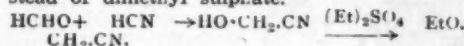
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PREPARATION OF ETHOXY ACETONITRILE

Just like methoxy acetonitrile the ethoxy compound is very useful for the synthesis of aromatic ketones. Several procedures¹ have been used for its preparation. The more important of these are the following:—

1. $\text{Cl} \cdot \text{CH}_2 \cdot \text{COOH} \rightarrow \text{EtO} \cdot \text{CH}_2 \cdot \text{COOH} \rightarrow \text{EtO} \cdot \text{CH}_2 \cdot \text{COOR} \rightarrow \text{EtO} \cdot \text{CH}_2 \cdot \text{CONH}_2 \rightarrow \text{EtO} \cdot \text{C} \cdot \text{CN}$
2. $(\text{Cl} \cdot \text{CH}_2 \cdot \text{COCl}) \rightarrow \text{Cl} \cdot \text{CH}_2 \cdot \text{CONH}_2 \rightarrow \text{Cl} \cdot \text{CH}_2 \cdot \text{CN} \rightarrow \text{EtO} \cdot \text{CH}_2 \cdot \text{CN}$

They involve a number of steps and the preparation, therefore, takes time and is also expensive. Method 1 was adopted during wartime in this laboratory² when simpler alternatives could not be explored. Experiments have now been conducted for preparing this useful reagent by the simpler and quicker procedure commonly adopted for preparing the analogous methoxy compound² using diethyl sulphate instead of dimethyl sulphate.



It is found that the reaction is considerably slower and the conditions have consequently to be modified in order to obtain the best yields. The following are the full details.

Powdered potassium cyanide (26 g.) was dissolved in water (75 c.c.) and the solution cooled to -5°C . in freezing mixture. Formalin (40 per cent., 35 c.c.) diluted with water (35 c.c.) was then added little by little with shaking. The temperature was not allowed to rise over 0°C . throughout this procedure. The mixture was left in the ice-bath for an hour with occasional stirring. Diethyl sulphate (55 c.c.) previously washed with ice-cold water was added all in one lot to the cold solution of formaldehyde cyanhydrin. The mixture was vigorously stirred with an electrical stirrer. As there was no visible reaction in the cold, the mixture was slowly heated to 45° in a water-bath. The heavy layer of diethyl sulphate at the bottom disappeared in about ten minutes and a lighter layer of ethoxy-aceto-nitrile appeared at the top. It was rapidly separated and diluted with anhydrous ether. Some more water separated out and was removed. The ether solution was then dried over anhydrous sodium sulphate. After evaporating the ether, the residue was distilled under reduced pressure (15 mm.) and the fraction distilling below 80°C . was collected. The yield was 6-7 c.c., and the product was pure enough for use in

the Hoesch condensation directly. With phloroglucinol it gave a good yield of *o*-ethoxy-phloracetophenone, and the ketone was identical with the sample already described.³ The nitrile could, however, be distilled again at atmospheric pressure and collected between 133° and 138°C .

Our thanks are due to Prof. T. R. Seshadri for his interest in this work.

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1. Sommelet, *Ann. Chim. Phys.*, 1906, 9, 493.
2. *Organic Synthesis*, 13, 56. 3. Row and Seshadri, *Proc. Ind. Acad. Sci.*, A, 9-6, 23, 140.

BACTERIAL SYMBIOSIS IN A MARGARODES SP.

To avoid confusion it may be mentioned that the Polish Cochenille insect, *Margarodes polonicus* L., has a red dye, as in the lac insect, and its symbiosis was being studied by Prof. Jakobski of Poland. Another species, feeding on grass roots, has been discovered by Sulc, at Brünn, and is evidently new to science. It is blue coloured, resembling unripe bilberries but free from any dye within its body.

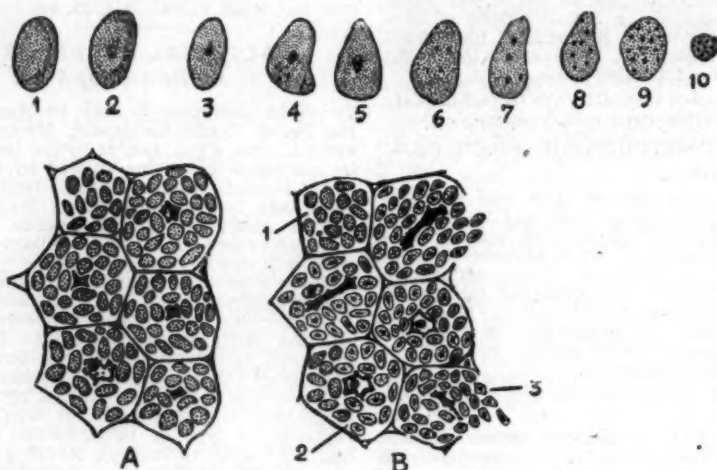
When a mature specimen of Sulc's *Margarodes* is dissected each ovary is found to contain a tumour-like growth which is carmine coloured and therefore conspicuous. This tumour has been called mycetome, but should now be designated bacteriotome. It has been illustrated by Sulc¹ and further mentioned by Buchner² in more than one treatise, as it would appear to represent a type of bacteriotome by itself. I had good opportunities of studying Sulc's *Margarodes*. In full-grown individuals the two ovaries have each a bacteriotome; but in immature insects the ovaries are connected by a bridge-like tumour with a constriction in the middle. This central narrow portion indicates that the bacteriotome subsequently separates into two exactly as Sulc has illustrated them.

Smears from the tumours belonging to immature insects were stained with Giemsa, the symbiotes proved to be delicate bacteria which have evidently escaped Sulc's observation. Even in thin sections, which are usually 5μ thick, the granule-like bacteria would not be clearly seen. The technique of making a smear—a technique not employed by Sulc—enables the identity of the bacteria. The symbiotic bacterium was successfully cultivated a number of times. The smears from cultures always compared well with those from the bacteriotomes.

Even apart from the fact that Sulc¹ has overlooked the existence of the bacterium, his interpretation of the symbiote as an yeast involves some confusion. On p. 16, Fig. 9 (1), he gives a section of the tumour attached to the ovary; a portion of this illustration is offered as Fig. A here with six tumour cells. Their cell inclusions are apparently some kind of yeasts. For this reason Buchner² calls the tumour in the *Margarodes* sp. a "Pilzorgan", although Sulc

himself is more diffident and designates the cell contents merely as symbiotes. In Sulc's¹ Fig. 9 (2), which is illustrated in part as Fig. B here, he gives the picture of the tumour in a more advanced stage. In Fig. B (tumour cell No. 1) the yeasts are identical with those seen in Fig. A; in both, the germs are immature. In Fig. B (tumour cell No. 2) some yeasts are immature while the rest are nucleated. The yeasts in Fig. B are relatively more developed—particularly those seen as cell inclusions in tumour cell No. 3 are fully mature and on their way to infect future eggs. To a critical observer Figs. A and B would strike as similar. They would hardly appear to have been drawn from a histological section or with a camera lucida and are more or less diagrammatic in representation. Such an idealisation appears to have

figures. What is interesting is to find in Nolte's Fig. 12, m., an identical stage with that of Sulc's Fig. 10 (10), or Fig. 10 here, although Nolte considers his germ a bacterium and Sulc, a yeast. In representing such life-cycles, white blood cells of insects, secretion granules and bacterial metabolic products have been confused; and the results, although based on correct observations, have to be very critically interpreted. For these reasons, a physiological test, like the production of a pigment *in vitro* by the culture of the symbiotic germ, conclusively proves the correct isolation of the symbiote. Neither the insect nor the symbiote produces any colour and hence the only finding that has to be emphasised is the existence of a bacterium in the smears from Sulc's *Margarodes*.



been applied also to the detailed study of the symbiote whose yeast-like nature he proposed to establish.

On p. 17 in Figs. 1 to 10, Sulc¹ gives the life-cycle of the symbiote. His illustrations are reproduced with his numerical indications. Fig. 1 is the youngest stage, then comes Fig. 2 and thirdly No. 3; all these forms are seen while the yeasts are in the tumour cell. The development occurs mainly in the formation of a nucleus-like central body which has been merely illustrated without any explanation. The symbiote, when it leaves the tumour, enters the lumen of the oviduct and shows more and more clearly the chromatin body as in Figs. 4 and 5. By the time it reaches the follicle it shows the development represented in Figs. 6 to 9. The yeast, finally ready for infecting the egg, is reduced in size but is rich in chromatin bodies resembling chromosomes, being the stage shown in Fig. 10—the end of a mysterious life-cycle of an unknown germ.

Nolte³ has carefully studied symbiosis in the beetle, *Erythrapin miniatum*. The symbiote is a bacterium, but with a complicated life-cycle, as in many other cases of symbiotes which have been studied only in sections and never in cul-

The work was undertaken, at Brünn, in the Laboratory of Prof. Sulc, to whom it is a pleasant duty to thank here again.

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1. Sulc, *Pub. bio. Ecole. Haut. Etud. veter.*, Brünn, 1923, 12, 16. 2. Bachner, *Erg. d. Biol.*, 1928, 4, 73. 3. Nolte, *Zeit. f. Morph. u. Okol.*, 1937, 33, 170.

RATE OF GROWTH OF DIPLOID AND TETRAPLOID YEASTS

The effect of duplication of chromosomes has been known to result in a change in the norm of reaction. In higher plants investigations show that the geographical distribution of the autotetraploids differ in many cases from those of the diploids. In fact, autotetraploids have been known from localities which are considered unfavourable to the diploids.

In yeasts duplication of chromosomes leads to a change in the characteristics of the giant

colonies.¹ Occasional spontaneous tetraploids could be seen as smooth sectors in giant colonies of the control (Photo 1, T). Since the

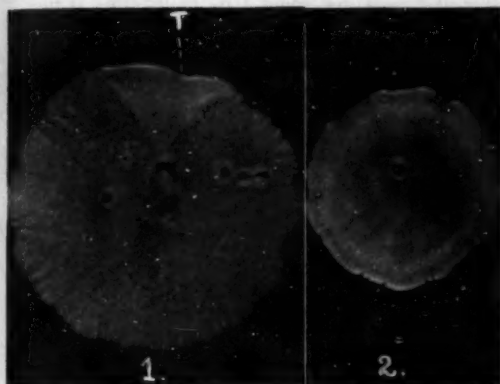
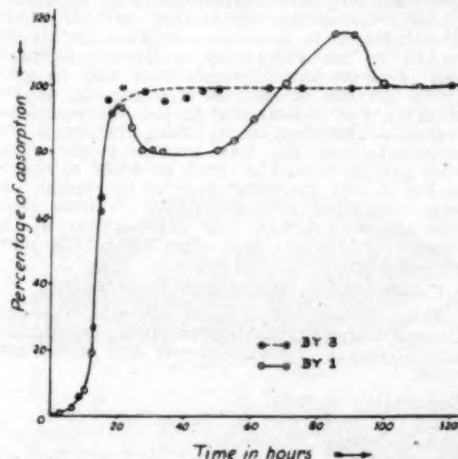


Photo. 1. BY 1. Ten day gr. wth. 2.5 cm. 30-9-1947.
Photo. 2. BY 1 + BY 3. Nine-day growth. 2.2 cm.

surface of the control has folds and striations, it is easy to distinguish between the diploid and the tetraploid. The contour of the sector indicates that its growth is more vigorous than that of the control. It was thought desirable, therefore, to study the structure of a colony developing from an inoculation of a mixture of the control and the tetraploid. Twenty four hour wort cultures of the control, BY 1, and a tetraploid, BY 3,^{2,3} were mixed



together, well shaken and inoculations were made immediately from this mixed culture. Photograph 2 shows the appearance of the colony after a nine-day growth. It has the typical appearance of the tetraploid colony, indicating that the tetraploid cells have completely eliminated the cells of the control strain by their rapid growth.

Investigations⁴ on the nutritional requirements of the diploid, BY 1, and the tetraploid, BY 3, showed no difference. From the data available it could not be judged whether the rate of utilization of the nutrients required for full growth are identical. Since the experiments with giant colonies showed that the rates of growth of the two strains are different, an investigation was carried out on their growth-rates in a standard all-vitamin synthetic medium.⁴ The growth of the yeast inoculated into 5 c.c. of medium in 100 c.c. conical flasks, incubated at 28° C., was measured at various intervals using a Lumetron turbidometer.

The diploid strain shows two cycles of growth. The logarithmic growth phase ends in 21 hours after which there is a fall in the curve which is followed by another steep rise indicating the second cycle of growth referred to by Richards.⁵ On the other hand, the tetraploid shows a quicker growth-rate and the end of the logarithmic phase is reached in 16 hours. The curve afterwards is parallel to the X-axis and does not show a second cycle of growth.

The difference between the diploid and the tetraploid is thus not limited to the changes in the colony characteristics alone. Duplication of chromosomes seems to affect a number of factors. The similarity of the growth curves of the tetraploid and diploid to that recorded by Richards⁶ for the same strain of yeast grown in media with and without colchicine is striking. Without either considering the possibility of polyploidy or a study of the behaviour of the colchicine-treated cells in normal media, Richards claimed not only that colchicine is a food and that it lessens the adverse effects of the increased quantities of toxic waste products released into the medium as a result of growth and fermentation, but also that colchicine fails to reveal mitosis.

From the observations recorded above, it appears that colchicine is neither a food nor is responsible for the disappearance of the second cycle of growth in the case of cultures in media containing the drug. Richards' results, in fact, offer evidence that colchicine has induced polyploidy.

We are very grateful to Sir J. C. Ghosh, Kt., D.Sc., F.N.I., for his active interest and encouragement, to the Council of Scientific and Industrial Research for generous financial assistance, and to the Council of the National Institute of Sciences (India) for the award to one of us (M. K. S.) of an Imperial Chemical Industries Research Fellowship.

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ENDOPARASITIC CHALCID OF *DELIAS* *EUCHARIS* DRURY

WHILE testing the effect of insecticides on different pests of citrus plants, it was observed that the pupa of *Delias eucharis* Drury, commonly known as Lemon Butterfly, was attacked by an endoparasitic chalcid which keeps down the population of the butterfly. It is mentioned in *Fauna of British India*¹ that "Large number are destroyed by a dipterous parasite very much like a common house-fly". So, it is probable that the life-history of the chalcid under investigation has not been reported so far. With this presumption the life-history of the endoparasitic chalcid is traced in this Laboratory.

The female chalcid introduces the egg into the body of the larva of *Delias eucharis* Drury when the larva is in last instar. In this instar the larva is in a state of inactivity and prepares itself for transformation into the pupa. Several larvae of the host were dissected to locate the position of the parasitic egg. It was found that the parasitic egg was in the dorsal region just below the body integument in the fatty tissue of one of the two anterior abdominal segments. So far it was found that only one egg is introduced into the body of the host larva. The eggs of the parasite are white in colour, with a thin egg membrane which is somewhat transparent. They are smooth, elongated and slightly curved in the middle as shown in Fig. 1. They mea-

sure about 1.3 mm. in length and 0.4 mm. in breadth.

The eggs of the parasite hatch out in 3 or 4 days. The newly hatched larva is white, apodous and measures about 1 m. in length. It has a reduced head which is sunk into the prothorax and thirteen trunk segments. The posterior region of the abdomen gradually tapers towards the tail end as shown in Fig. 2. The parasitic larva is carnivorous in habits and feeds on the organs of the host which are undergoing histolysis and develops rapidly. It was observed that the pupa of the host develops brown patches on the surface as soon as the internal damage is caused. The parasitic larva attains full growth in 5 to 7 days. The cuticle of the mature larva is extremely thin and transparent. The larva measures about 1.2 cm. in length and 0.5 mm. in breadth in the middle. However, the number of ecdysis could not be counted during the growth of the larva.

Pupation of the parasitic larva takes place within the pupa of the host; and at this stage the pupa of the host is empty with some putrefying tissue scattered here and there. The parasitic pupa is of exarate type with no cocoon or case around it. The pupal stage extends to 5 to 7 days.

The adult chalcid comes out of the pupa of the host by making a circular opening, usually in the thoracic region, as shown in Fig. 3 A. The chalcid is a small, black, shining insect measuring about 0.6 mm. The female is slightly larger in size than the male. The head capsule is more or less triangular in shape with two large prominent eyes, surrounded by dense growth of fine white hair. The antennae are elbowed, and spring a little above the clypeus. The thorax is more chitinous, rough, punctured all over and is densely clothed with fine hair. The abdomen is basally constricted and is attached to the thorax by a slender segment, and is somewhat flattened from side to side. Dense growth of hair is also present on the abdomen but is restricted to the intersegmental regions. The most conspicuous feature is the construction of the legs and its colour. The hind pair of femurs is much enlarged as shown in Fig. 4, and the distal ends of the femur and tibia down the legs are yellow. These chalcids are very active, and they appear in the months of August, September up to the middle of August.

Further work is under progress.

I am thankful to Dr. M. Qureshi, Director, Central Laboratories for Scientific and Industrial Research, for his interest and encouragement.

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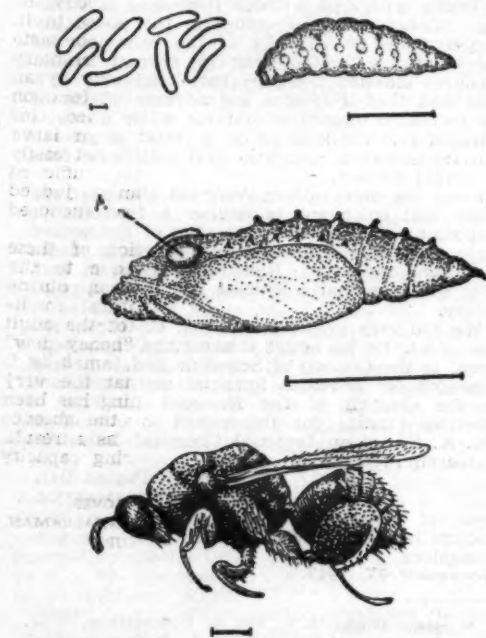


FIG. 1. Chalcid Eggs.

FIG. 2. Chal. id Larva.

FIG. 3. Pupa *Delias eucharis*

FIG. 4. Adult Chalcid.

1. *Fauna of British India Butterflies*, 1907, 2, Bingham.

ON THE FUNCTION OF THE "FEEDING TUBES" OF *BRACON (MICROBRACON) GREENI* ASHM.

Bracon (Microbracon) greeni Ashm. is a primary monophagous ecto-parasite of the larva of *Eublemma amabilis* Moore (Noctuidae), a predator of major importance on the lac insect *Laccifer lacca* Kerr. (Coccidae).

The female parasite lays her eggs, on or near the host larva lying concealed within its gallery in the lac encrustation, after she has paralysed it by stinging it from 3-6 times with her ovipositor, a process which takes from 5-10 minutes. The neuro-toxin injected takes some time to bring about complete paralysis, and oviposition begins before absolute immobility has been achieved. Paralysis is not always complete, and the host may temporarily retain, or regain some measure of mobility. Occasionally stinging is entirely ineffective.

Prior to oviposition the Braconid usually constructs one or more tubular strands, from the host body to the inert covering, by working her ovipositor slowly upwards and downwards starting from the point of puncture of the host cuticle and ending at the inert covering through which the ovipositor is finally withdrawn; rarely an extension may be seen on the upper surface of the latter. These tubes are formed by a secretion from glands in the abdomen of the female parasite which oozes on to the ovipositor together with a certain quantity of the body fluid of the host. They are glistening, translucent and have a very fine lumen; when first constructed they are tough and somewhat elastic, though they become brittle after 3-4 days. They occur most commonly on the dorso-lateral surface of the thoracic and abdominal segments of the host, and there may be as many as 10, but 1-3 is the normal number; their normal length varies from 0.5 to 5.0 mm., being in fact dependent on the space intervening between host and covering. Incomplete tubes are sometimes found, or tubes may be entirely lacking.



Semi-diagrammatic sectional view of an *Eublemma amabilis* larva, within its larval gallery, parasitised by *B. greeni*; showing "feeding tube anchoring strands" constructed by the parasite

D. Inert covering of gallery, of webbing, excretal pellets and lac trass.

E. Egg of *B. greeni*.

S. "Feeding tube anchoring strands".

S. M. Stinging marks left by ovipositor of *B. greeni*.

The construction of such tubes and their use for feeding on host larvae lying concealed in

tunnels or galleries has been described in a number of genera of several families of parasitic Hymenoptera, and is particularly common in the genus *Microbracon*. Genieys¹ has found that feeding on the body of the host is essential for oviposition in *Habrobracon*. Flanders² has shown that if insufficient protein has been stored up during larval growth, a protein diet is essential before normal oogenesis can take place in certain parasites, and that the body fluids of their hosts provide a suitable source of protein.

In the laboratory, *B. greeni* females were provided with 2-5 per cent. cane sugar solution for feeding. Feeding tubes were regularly constructed, but in no instance, over many years of laboratory breeding work, was the female Braconid ever observed to feed directly or indirectly through them. *B. greeni* clearly does not require a protein diet in the adult stage for normal oogenesis. Even when deprived of sugar solution and provided with water only, these tubes were not exploited for obtaining food, even though both fertility and longevity were impaired in comparison with females not so deprived.

It is suggested that these strands constructed by certain of the parasitic Hymenoptera, have in fact a dual role, serving both as feeding tubes and as anchoring strands. In this latter capacity, they assist in holding the partially paralysed host larva motionless, and prevent it from dislodging the eggs laid on its body, or damaging those laid in the gallery close to it, by movements prior to the onset of complete immobility, and thereafter by involuntary movement due to shaking of the gallery by an external agency such as wind. Their function in this capacity is not long required, for the egg has hatched and the first instar larva has attached itself to the host; it is not easily dislodged. That the strands have sufficient tensile strength for this purpose can be judged by attempting to move a larva so anchored with a needle.

In *B. greeni* the feeding function of these tubes is not exploited, probably due to the fact that sufficient protein is stored up during larval growth and that under natural conditions the nutritional requirements of the adult are met by the readily available "honey dew" excreted by *L. lacca* on which *E. amabilis* is predatory. Further, it appears that the very habit of using these tubes for feeding has been entirely lost in *B. greeni*, even in the absence of other sources of food, and that as a result, the tubes function in their anchoring capacity only.

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A GLOMERELLA ROT OF NUNA

A rot of fruits of *nuna* (*Anona reticulata*, Linn.) was observed for the first time in an orchard at Rainagar, Sylhet, in December 1944. The disease was quite severe: nearly 15 to 20 per cent. of the fruits were affected. A survey made throughout the district of Sylhet revealed that the rot occurs wherever *nuna* is grown. The disease has also been prevalent in subsequent years causing appreciable loss wherever found.

The rot usually appears during the middle or later part of December. It starts usually but not always from the blossom-end of the fruit; it may start also from any other point. A dirty blackish-brown spot first appears which gradually but very slowly spreads in all directions. The rot is a dry one, and the tissues of the fruit remain quite hard and in tact. The rot advances usually from the bottom upwards until the entire fruit is affected after which it is gradually transformed into a dry shrivelled mass which either remains hanging or falls to the ground. On cutting open a diseased fruit it is found that the substance of the fruit inside has become a black shrivelled mass of tissue, hard to feel and very light in weight. Fig. 1 shows the early symptoms of the disease.



The fungus causing the rot appears on the diseased surface of the fruit as a scanty whitish growth immediately after the onset of the rot. But soon conspicuous pinkish incrustations appear, and the whitish growth becomes almost non-existent. This pinkish growth shows under the microscope innumerable unicellular, hyaline spores. They are straight, often taper slightly at both ends, and measure $10-20 \times 3-6 \mu$ (average $16.2 \times 4.1 \mu$). After sometime, by the side of the pinkish growth blackish masses of fungal growth are noticed. These show clusters of perithecia containing asci and ascospores. The perithecia are pear-shaped, membranous, dark brown but lighter towards the tip. They

are formed on or partly immersed in a loose stroma of light brown, interwoven hyphae. They measure $220-300 \times 90-210 \mu$ and contain numerous asci without paraphyses. The asci are clavate, sessile, $40-70 \times 7-11 \mu$, and each contains eight spores. The ascospores are somewhat like the conidia, but are often slightly curved and measure $13-22 \times 4-6 \mu$ (average $19.2 \times 4.8 \mu$).

A large number of isolations were made. Single spore cultures were taken both from conidia and ascospores. The growth characteristics of the fungus grown on oat agar were studied. The mycelial growth was poor but the fungus produced large ochraceous salmon-coloured spores, and later produced perithecia with asci and ascospores. Cultures from conidia and ascospores manifested identical characteristics, and both formed the imperfect and the perfect spore forms. The morphological characters of the different spore forms agreed with those found in nature and the measurements were the same.

From a study of the morphological characters of the fungus it was found that the measurements of the different spore forms agree with those of *Glomerella cingulata* (Ston.) Spauld. and v. Schrenk, given by Shear and Wood.¹ Hence the fungus under study is identified as *G. cingulata*.

Infection experiments with pure cultures of the fungus on sound fruits in the laboratory and in the field established the pathogenicity in the usual manner.

As the rot is a serious one and causes considerable damage, experiments for its control were carried out during the years 1945 and 1946. It was found that spraying the fruits with 2:2:50 Bordeaux mixture as soon as the rot makes its appearance or just before the time of its usual occurrence completely controls the disease and saves all the unaffected fruits.

So far no fruit rot of *A. reticulata* due to *G. cingulata* has been reported.

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A PRELIMINARY NOTE ON THE
KARYOTYPE IN *CAPSICUM*
FASTIGIATUM BL.

Most of the varieties of chillies fall under the two well-known species *Capsicum annum* Linn., and *C. frutescens* Linn. A third species, *Capsicum fastigiatum* Bl., with small apogectropic fruits have been reported from the malnad areas of the Mysore State and in and around Bangalore.¹

Root tips were raised in pots and fixed in Lewitsky's fixing mixture and stained with Crystal Violet. The somatic count of 24 chro-

mosomes (Fig. 1) accords with the number reported by Raghavan and Venkatasubban² for



Fig. 1. X 3600



Fig. 2. X 3600

the South Indian varieties. A study of the morphology of the karyotype has revealed that nine pairs have sub-median constrictions, two pairs, median constrictions, and one pair alone, sub-terminal constrictions. One of the sub-median pairs shows a prominent secondary constriction (Fig. 2).

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IMPORTANCE OF RESERVE FOOD MATERIALS IN SUCCESSFUL ESTABLISHMENT OF SHOOT-CUTTINGS IN *COFFEA ROBUSTA*, L. LINDEN

THE literature on Vegetative Propagation of Coffee is fairly extensive, most of these coming from Java, Kenya, Tanganyika, Puerto Rico, Mysore and, to a less extent, from Sidapur. But there have been few published data where-in stress has been laid on the part played by reserve food material.

The role of carbohydrates in the successful rooting of stem cuttings in plants has been recognised by Goebel,¹ Loeb,² Winkler³ and others. But its importance has gone to the background with the advent of the discovery and study of the natural and synthetic growth-regulating substances.

While tackling the problem of the establishment of Dadap stakes (*Erythrina lithosperma*,

Blume) in coffee estates, it was found that cuttings from flowering branches (with high carbohydrate reserves), established themselves better than those from actively growing ones. It was found possible to bring about analogous physiological condition in the growing Dadap branches, by ring-barking them at their bases. The idea is similar to that of Reid,³ who showed that ringing in tomatoes raises the C/N ratio in parts above the ring.

The same principle was extended to our work on Robusta coffee. The table below gives the results of two experiments. Single node leafy cuttings from suckers were used. All the primaries were cut off prior to planting. The ringing was done one month before planting.

TABLE
Effect of Ringing in Rooting of Cuttings in R. Coffee

	Planting date	Observation date	Number planted	Number rooted
EXPERIMENT I.				
From ringed suckers	5-12-1946	5-4-1947	60	23
From unringed suckers	5-12-1946	5-4-1947	60	16
EXPERIMENT II.				
From ringed suckers	27-6-1947	20-9-1947	50	37
From unringed suckers	29-6-1947	20-9-1947	50	3

In experiment I, the ring-barking was done at one node only, and not much growth in general was noticed after the date of the operation. This would indicate that the C/N position in both type of cuttings were not widely different. However, in experiment II, the ringing was done during a vigorous growing period, and it was done at every internode. This resulted in far greater increase in C/N in the internodes between the rings than the un-ringed parallel cuttings.

The two experiments, though conducted during different parts of the year, demonstrate the importance of the reserve food material in better establishment of Robusta coffee by cuttings. A method has been indicated for obtaining that physiological condition in the planting material. Experiments were conducted in propagating frames in a randomised design. As a frame cannot accommodate more than 100 or 120 Robusta cuttings, further work on a large-scale is planned to be conducted in open nursery beds during the next south-west monsoon period. Details of the work will be published elsewhere.

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A SHORT NOTE ON A CASE OF DOUBLE-DIGITATE INFLORESCENCE IN *DACTYLOCTENIUM AEGYPTIUM* WILLD.

THE normal inflorescence of *Dactyloctenium aegyptium* Willd. is of digitately radiating spikes in a single whorl (Fig. a) the number of spikes varying up to 7 and rarely reduced to a solitary spike. But many plants of this species were observed carrying a second whorl with 1 to 4 spikes, on a short rachis above the first (Fig. b), in a field which was heavily



Single digitate (of 5 spikes-normal) (a)

Double digitate (the 2nd whorl of 3 unequal spikes) (b)

manured and had a standing crop of castor. Both the types of inflorescences with single digitate and double digitate spikes were present in one and the same plant in many cases. In a few, thumbs similar to those that are present in *Eleusine coracana* Gaertn., were also observed.

The progenies raised from the seeds of such plants in pots under laboratory conditions failed to exhibit either the freak of a double digitate inflorescence or that with the thumb. It is, therefore, presumed that the environment was responsible for the expression of those characters.

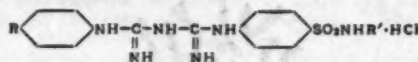
It is interesting to note in this connection that this species, *Dactyloctenium aegyptium*, is very variable in its inflorescence character in that the number of spikes may vary from one in poor alkaline soil to as many as 9, as observed by the authors at Krusadi—an island in the Gulf of Mannar, Ramnad District; the length of the spikes and their width ranged from 0.5 cm. to 4.5 cm. and 0.2 cm. to 0.8 cm. respectively. These are of interest from the ecological point of view.

Madras Herbarium,
Agricultural College and
Research Institute, S. N. CHANDRASEKHARAN.
Lawley Road P.O., D. DANIEL SOUNDARAJ.
Coimbatore.
November 8, 1947.

STUDIES IN ANTIMALARIALS: SULPHABIGUANIDE DERIVATIVES

IN a previous communication,¹ we have reported some sulphabiguanide derivatives of type A which have a tautomeric biguanide structure combined with well-known sulphonamide deri-

vatives. These compounds have now been tested for their suppressive antimalarial activity against *P. gallinaceum* in chicks and the results have been tabulated below.



... Type A

R = H, Cl, Br, Me, etc., and R' = H, 2-thiazolyl and 2-pyrimidyl.

Suppressive antimalarial activity of "Sulphabiguanides"

(*P. gallinaceum* in chicks)

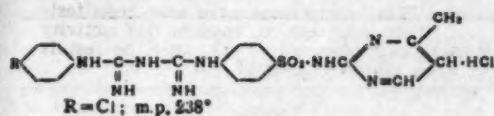
-, not active; +, slightly active; ++, active

No.	R	R'	Dosage in mgs. per 100 gms. body weight	Activity
1	Cl	H	6	-
			12	-
2	CH ₃ O	H	6	-
			12	-
3	Br	2-thiazolyl	20	-
4	Cl	do	40	-
5	CH ₃	do	40	++
6	H	2-pyrimidyl	40	++
7	Cl	do	40	+
8	Br	do	20	-
9	CH ₃ O	do	20	++
10	NO ₂	do	20	-

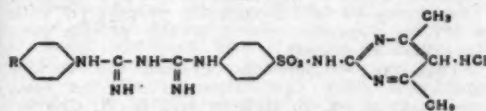
From the above results, it may be concluded that when the sulphonamido group is unsubstituted the compounds are inactive, while its substitution with pyrimidine ring gives compounds of considerable activity with higher dosages.

Recently Curd and Rose² have put forth an explanation for a possible mode of action of paludrine, wherein the activity is attributed to formation of metallic complexes (Chelate rings) with trace elements in vivo and thus depriving the parasite of its mineral requirements. It has been shown that metallic complexes are formed with considerable difficulty in the case of aryl-substituted biguanides,^{3,4} and in fact N¹- and N⁵-diaryl-substituted biguanides have been shown to be inactive as antimalarials.⁴ Compounds of type A are also N¹-N⁵ diaryl-substituted biguanides, but their activity, when they are suitably substituted, may show that formation of a metallic complex alone is not responsible for activity and their anti-plasmodial action seems to depend upon the nature of the substituents on either end of a tautomeric biguanide structure.

Sulphamerazine and sulphamethazine are two new alkyl-substituted sulphadiazine derivatives which have shown good antimalarial activity.^{5,6} In the light of the present finding it was thought of interest to prepare compounds of type B and C in order to study the effect of alkyl-substituents in the pyrimidine ring as regards their antimalarial activity.



Type B



Type C

Further derivatives having different substituents in the N¹-aryl nucleus are being prepared. These compounds have been prepared by the interaction of arylcyanoguanidines^{1,4} and hydrochloride of sulphamethazine or sulphamerazine in boiling 95 per cent. alcohol. These salts are white amorphous powders and are crystallised from aqueous dioxan. Details of the present work will be published elsewhere.

Our thanks are due to Dr. N. N. De and Dr. K. P. Menon under whose direction the pharmacological testing of the compounds was done. We thank the Indian Research Fund Association for the award of a Fellowship to one of us (H. L. B.) which enabled him to undertake this work.

H. L. BAMLI.
B. H. IYER.
P. C. GUHA.

Organic Chemistry Laboratories,
Dept. of Pure & Applied Chemistry,
Indian Institute of Science,
Bangalore,
December 5, 1947.

1. Bamli, Iyer and Guha, *J. Indian Inst. Sci.*, 1947, **29A**, 15. *cf. Curr. Sci.*, 1947, **16**, 252. 2. Curd and Rose, *Nature*, 1946, **158**, 707. 3. Ray, P., *J. Indian Chem. Soc.*, 1937, **14**, 670. 4. Curd and Rose, *J.C.S.*, 1946, 729. 5. Davey, D. G., *Ann. Trop. Med. and Parasitol.*, 1946, **40**, 453. 6. Findly, G. M., *et al.*, *Ibid.*, 356.

FINITE PURE FLEXURE

ONE of the fundamental results in the mathematical theory of elasticity in the Bernoulli-Euler law of pure flexure which says that when

WHY IS THE OCEAN BLUE?

A NEW answer to this age-old question has been found as a by-product of some wartime research on the use of light rays in anti-submarine warfare. F. A. Jenkins (U. of Cal.) and I. S. Bowen (Mt. Wilson) in 1941 discovered that there exists in every cubic inch of clear ocean water about a million and a half dust-like particles, each about one fifty-thousandth of an inch in diameter. The suspended particles were discovered and counted with an ultra-microscope. These particles reflect sunlight back to the ocean surface. But the light that gets back to the surface has been filtered: water absorbs the red and yellow colours of light, leaving greens, blues, and violets, the combination of which is the indigo blue common to deep ocean water. Previously the explanation for this colour had been attributed

a beam is bent by terminal couples the bending moment is proportional to the curvature of the central line. This law is widely used in the theory of flexure of prisms, continuous beams and bending of plates and rods. In the case of plates it is known that, if $2b$ is the thickness of the plate and ρ the radius of curvature in the plane of bending, then for small values of (b/ρ) the moments of the applied couples M_1 , M_2 per unit length applied to the straight and circular edges are (D/ρ) and $(\eta D/\rho)$, η being Poisson's ratio and D the flexural rigidity of the plate. It will, therefore, be of interest to know what form these relations take for finite deflections when (b/ρ) is not small.

If a rectangular plate is bent by terminal couples into a cylindrical shape of inner radius a and outer radius b the theory of finite strain gives the values of the two couples M_1 and M_2 as¹

$$M_1 = \mu \left[\frac{1}{2}(b^2 - a^2) - \frac{(2-c)(\log b - \log a)(ab)^{2-c}(b^2 - a^2)}{c(b^{2-c} - a^{2-c})} \right] \quad (1.1)$$

$$M_2 = -\frac{\lambda}{a} \left[\frac{1}{2}(b^2 - a^2) - \frac{2-c}{3-c}(b^2 - a^2) \frac{b^{2-c} - a^{2-c}}{b^{2-c} - a^{2-c}} \right] \quad (1.2)$$

where $c = (1-2\eta)/(1-\eta)$.

If ρ is the curvature of the middle surface, we find, to the second order of (b/ρ)

$$M_1 = \frac{D}{\rho} \left[1 - \frac{1}{15}(2-6c+c^2) \frac{b^2}{\rho^2} \right] \quad (2.1)$$

$$M_2 = -\frac{\eta D}{\rho} \left[1 - \frac{1}{60}(13-7c)(1-c) \frac{b^2}{\rho^2} \right] \quad (2.2)$$

which show that M_1 can be greater or less than D/ρ but $|M_2|$ is less than $\eta D/\rho$.

For $(b/\rho) = 0.2$, $c = \frac{1}{2}$ ($\eta = \frac{1}{2}$) we find from (1)

$$M_1 = 1.002 (D/\rho), \quad M_2 = -0.997 (\eta D/\rho).$$

It appears that the Bernoulli-Euler theorem can also be used with sufficient accuracy for finite deflections when (b/ρ) is not small.

Hindu College,
Delhi,
October 7, 1947.

B. R. SETH.

I. Seth, B. R., *Phil. Trans. Roy. Soc.*, 1935, **234**, 244.

REVIEWS

Capacitors—Their Use in Electronic Circuits.

By M. Brotherton. (Van Nostrand Company Inc., New York), 1946. Pp. 104. Price \$3.00.

"This book is not a treatise on capacitors and neither depth nor originality is claimed," states the author in his Foreword to this useful little book. However, a perusal of it is bound to furnish useful hints regarding the use of these not-quite-understood circuit elements which are so essential in building up any electronic or communication equipment. Though its perusal may not make the reader an expert in the subject, it will help to remove a number of kinks in regard to understanding their behaviour and their subsequent successful applications in practical circuit design.

The book is divided into 9 chapters preceded by a very readable introduction and a summary of practical types of capacitors. Subjects discussed are stability, a.c. resistance, leakage, temperature characteristics and its effect on life of capacitors, etc., all from the view-point of a user. Capacitors using paper, mica, ceramic materials and air as dielectric as well as electrolytic types are each devoted a chapter though information about impregnated paper capacitors takes a major share. A few references to other works on the subjects are given for the more interested reader.

The book will generally be found useful as a quick and readable account of idiosyncrasies of various types of this essential electrical circuit element which is not always well understood and yet is always blamed for mishaps to electronic equipments, often out of sheer ignorance.

N. B. BHATT.

Some Aspects of Red Cell Production and Destruction. *Annals of the New York Academy of Sciences*, 1947. Vol. XLVIII, Art. 7, pp. 577-704. Price \$2.00.

In the above volume, eminent Haematologists have reviewed the recent work on the various aspects of the production and destruction of the red blood corpuscles.

Eric Ponder has dealt with the red cell cytochemistry and architecture and states that we are still in the stage of collecting observations and cannot expect to see more than the outlines of the picture. He points out that the components of either the surface structure or the internal structure or both are so arranged as to give the cell its characteristic biconcave discoidal shape. From observations on disc-sphere transformations produced by lysins, the shape-component may be considered to be a supporting ultra-structure, probably, but not necessarily, situated at the surface of the cell, and the permeability-component as being a layer or membrane, only a few molecules thick, situated somewhere in the thickness of the ultra-structure. The analytical data show that 40 to 60 per cent. of the lipid is bound to protein as lipo-protein with considerable differences in different species. There is good evidence

that the thickness of the surface is not uniform. The region of the biconcavity is covered with a thicker structure with a greater protein content than elsewhere.

The possible relation between the various endocrine glands and Haemopoiesis has been discussed by A. S. Gordon and H. A. Charipper. The supposition that the pituitary produces a specific haematrophic factor, they state, is open to question since various, already established, trophic principles have been found to display considerable erythropoietic properties. There is no clear-cut evidence to indicate any role of the posterior pituitary in the erythropoietic process. A relation between the thyroid and erythropoiesis is suggested. Adrenal cortical hormones produce lymphopenia and neutrophilia. Evidence is presented to suggest that the gonadal secretions are responsible for the normal sex difference in red cell count detected in many species of animals. It is usually the male animal which reveals the higher red cell and haemoglobin values. Further investigation is required to find out whether the haemopoietic effects exerted by the various hormones are manifestations of their action on general phases of metabolism in the body or of their direct action on the blood-forming tissues.

F. S. Robscheit-Robins discusses the various factors affecting the haemoglobin and red cell production in experimental haemorrhage anaemia and points out the importance of diet intake, particularly of certain amino-acids, and iron reserves in the body.

S. Granick deals with iron and porphyrin metabolism in relation to the red blood cell. After describing the structural details of heme units, he points out that the iron required for the manufacture of the heme of the red blood cells is about 3.0 gm.: that is, about several hundred times as much iron is required for the red blood cells as for all the other body cells combined, excluding muscle haemoglobin, and that specific mechanisms to ensure this supply have been developed in the body. It is interesting to note that a special mechanism exists for the regulation of iron absorption. The ferrous iron is converted to ferrous iron by reducing substances in the food at the acid pH of the stomach. Ferrous iron entering the mucosal cells mostly in the region of the duodenum brings about a rapid accumulation of the specific protein, apoferritin, to which the iron attaches itself in the form of micelles of ferric hydroxide, the resulting compound being called "ferritin" discovered by Laufberger. In the mucosal cells, the ferric iron of ferritin is in equilibrium with the ferrous iron. The formation of ferritin helps to maintain the ferrous iron in a state of physiological saturation for several days, thus preventing the absorption of excessive amounts of iron. As ferrous iron moves out into the blood-stream, it is rapidly autoxidised to ferric iron, attaching itself to the β_1 globulin fraction of the serum. In this

manner, it is transferred to the liver, spleen, and marrow, where it may be stored as ferritin or directly utilised by the marrow in the synthesis of heme. We are still ignorant of why the iron brings about the accumulation of apo-ferritin; what enzymes are connected with the dissolution of iron from ferritin; and what enzyme systems are connected with the incorporation of iron into the protoporphyrin ring.

The author further deals with the mechanism of heme synthesis and chemistry of normal heme decomposition. He refers to the fundamental discovery of Shemin and Rittenberg (1945) that glycine labelled with heavy N is the nitrogenous precursor of the pyrrole ring. Acetic acid also appears to participate in this synthesis. Much yet remains to be learned as to how pyrroles are formed from glycine and acetic acid.

William B. Castle refers to Agren and Waldenstroem's recent report that an amino-polypeptidase derived from hog gastric mucosa potentiates the hæmato-poietic activity of orally administered liver in pernicious anaemia and infers that the aminopolypeptidase presumably acts as the gastric (intrinsic) factor. The nature of the food (extrinsic) factor still remains uncertain. He further observes that purified fractions of liver extract possess distinctly greater activity in pernicious anaemia than does folic acid on a comparative dry weight basis.

William Dameshek reviews the literature on hæmolytic mechanisms and discusses the effects of hæmolysins and agglutinins, the passive nature of erythrocytosis and the role of the spleen as well as such physical factors as cold, heat, hydrogen-ion concentration, etc.

This volume is of great value to students and workers in the field of Hæmatology.

B. T. KRISHNAN.

Van Nostrand's Scientific Encyclopedia. 2nd Edition, 1947. Pp. 1,600. £3-5 net.

This volume, like the previous one, is a mine of scientific information brought up to date both as regards the number of scientific subjects and the terms dealt with under each subject. There have been added to this edition new sections on Electronics and Radio, Metallurgy, Meteorology, Photography and Statistics. The sections on Aeronautics and Engineering sciences have been considerably expanded.

A particularly advantageous improvement in the facility of reference in this edition is the system of cross-indexing that has been developed. This enables the reader to collect easily the maximum of information that bears directly on all included topics. Every description is concise and perfectly lucid. The numerous illustrations make the comprehension of subjects still more easy. The meticulous care of the authors together with their cross-referencing, the small, neat print and the durable get-up have contributed in great measure to the inclusion of so much material within the covers of one volume. The reviewer, however, feels that the editors and publishers have been a little too ambitious in including such a vast number of scientific subjects in a single, wieldy volume. The natural consequence is that the *Encyclopedia* fails to fulfil its purpose of being

exhaustive. A random sample survey showed, for instance, that Choline, Acetylcholine and Phosphatide are missing under chemistry, and phage, Bacteriophage, Salmonella and Glycæmia are not included among the medical terms. Interference, as an optical phenomenon, has not been described. Neither Insecticides nor Gammexane find a mention in the volume. An Engineer might miss quite a few in his subjects. Instead of, therefore, trying to be so entirely comprehensive, it will be far more useful if the editors could plan two volumes, one for pure and the other for applied sciences. Such an effort has obvious advantages.

Considering the volume of printed material in the book, errors are far too few indeed. The reviewer came across hardly two printer's mistakes—one (p. 68, line 37) haloid for halide, and the other, a little less excusable, (p. 1070, line 9), in the formula for pyrogallol, $C_6H_3(OH)_3$ for $C_6H_4(OH)_3$.

We are confident that the famous publishers will bear these suggestions in mind and improve upon the present edition even as they have done on the last one.

With all the minor defects and omissions this is a 'must' reference book, as the Americans call it, for every science library.

K. S. R.

Enzymes and Their Role in Wheat Technology. American Association for Cereal Chemists Monograph Series. Edited by J. Ansel Anderson. (Interscience Publishers, Inc., New York), 1946. Pp. 371. Price \$4.50.

This volume is the first of a projected series of monographs sponsored by the American Association of Cereal Chemists, "primarily as a service to its members". The book starts off with a good chapter on the general chemistry of enzymes. Then follow twin chapters for each of the particular enzymes—amylases, esterases, oxidases, proteases and the fermentation enzymes, every chapter being written by a specialist. In the first of these twin chapters a fairly general treatment of the enzyme concerned is given, while the second chapter is meant to be a discussion on the part played by that enzyme in wheat technology. Each chapter comprises a bibliography, besides the usual author and subject index at the end of the book.

Although an avowed purpose of the book is its emphasis on the role of enzymes in wheat technology, the elaborate treatment of the pure chemistry of enzymes appears rather out of balance in the book. The editor is not altogether unaware of these faults. Here is his apology: "With several authors involved . . . a certain amount of overlapping is difficult to avoid." It is still difficult to understand the inclusion in the text of any treatment on enzymes that have no or very doubtful role in wheat technology. Chapter V on esterases is just a case in point, best illustrated by the following remarks of the author of this chapter (p. 153): "The esterases of plants have not been investigated as extensively as the amylases and the proteolytic enzymes and, therefore, a discussion of the function of the esterases as applied to milling and baking problems is

necessarily limited" and "... since data in this field are no meagre, it will be necessary to borrow freely from research done on other enzyme sources, both plant and animal."

If there were an International Board of Editors, rigidly regulating the publication of technical books in strict conformity with current needs and economy standards, it is doubtful whether the book would be passed as it is.

But all this is not to deny the excellent get-up of the book and the profundity of certain of the chapters on the pure chemistry of enzymes, notably those on oxidases and proteases. It is hoped that the less initiated wheat technologist will find himself able to drink deep at this well of knowledge.

S. N.

Methods of Vitamin Assay. Published for the Association of Vitamin Chemists, Inc., by Interscience Publishers, Inc., New York, 1947. Pp. 189. Price \$3.50.

The difficulties felt even by the experienced analyst in vitamin assays in natural products are in no small measure due to the lack of a single co-ordinated procedure for the analysis of a particular vitamin in a given material. The methods gathered from literature and adopted, vary very widely for the different materials, and the accuracy of results obtainable by each being doubtful, the analyst is usually thrown back on his own resources to select the procedure best suited to him and devise his own modifications. Much of the confusion is due to the omission of necessary details of procedure in the technique. The analytical methods showing specificity to the operators is also a common experience, even to the skilled analyst, when methods reported to be applicable do not give concordant results at his hands. The literature on analytical procedure for vitamins is vast and varied. Every vitamin analyst must have felt how welcome it would be to have on hand a publication containing a detailed description of the tested and authentic analytical methods for vitamins in different materials.

In publishing this handy manual the editors have satisfied a long-felt need, an din their treatment of the subject have shown real appreciation of the difficult task they have undertaken and have conspicuously succeeded in bringing out a work of merit.

The book under review is the result of collaborative effort of the Association of Vitamin Chemists, founded in 1943, with the co-operation of experts from scientific laboratories all over the country. The various methods for the assay of different vitamins described in the book are those which have been verified by collaborative assay.

The important aspects of the sampling, preliminary treatment and methods of calculations are given in the commencing chapter. Detailed description of standard methods for assay and calculation for the vitamin A and its precursor, vitamins B₁ and B₂, Nicotin and ascorbic acid are given in the following chapters. The rest of the vitamins for which critically evaluated methods are not yet available are listed in the eighth chapter with references to literature. In the concluding chap-

ter the use of check samples in control of vitamin methods and the preparation and storage of the samples used in standardisation of methods are discussed. Wherever details are necessary for accuracy, emphasis has been laid on them and explanation given at length.

A notable feature in the various chapters is the detailed notes on each method together with a complete list of apparatus, chemicals and working of instruments used in the analysis. Reference to literature at the end of each chapter adds to the usefulness of the book. Perhaps inclusion of a list of vitamin contents of natural products would have been a welcome feature.

C. N. BHIMA RAO.

Annual Review of Biochemical and Allied Research in India, Vol. 16, 1945. (Society of Biological Chemists, Bangalore, India.) Price Rs. 3.

The present issue of the Review, like the previous ones, comprehensively reviews the researches in Biochemistry including the related aspects of medicine and nutrition in India. Giri and Das have summarised the work on Enzymes, describing in some detail new methods of estimation of enzymic activity, and of biological constituents with enzymes. Researches carried out in 1946 have also been included in this section. Bashir Ahmed and Vohra have brought together the work on the various vitamins. The finding that shark liver oil derived from low pressure extraction is far less rich in vitamin A than steam-extracted oil promises scope for further work, and the fact that calciferol, as a substitute for ergosterol, fails to support the growth of certain larvae perhaps explains why calciferol sometimes fails as a cure for human rickets. It is also noteworthy that the symptoms of ascorbic acid deficiency might manifest themselves in the form of pseudoparalysis in the absence of scurvy.

Ranganathan's review on general Nutrition draws attention to the importance of careful and correct presentation of scientific findings to the public as, otherwise, wrong notions (like cooking in copper vessels to preserve vitamin C in food) on an important subject might take root in the minds of lay people. Gross deficiencies in protein, fat, meat and milk in the Indian diet have been stressed as usual, and references have been made to suggestions for ameliorative measures.

A notable observation in nutrition is that while casein and calcium lactate either singly or together exert a growth-promoting effect on a predominantly carbohydrate diet, butter alone has an adverse effect, but together with casein exerts a beneficial effect. This naturally indicates either that casein makes up, as the workers have suggested, a factor deficient in rice for the utilisation of dietary fat, or serve to counteract a possible inhibitory effect of butterfat. In this connection, it is not quite correct to state that calcium lactate is an ingredient of milk, for most of the calcium in milk exists in combination with protein, and not at all as a salt of lactic acid.

The changes in the content of the vitamins of the B complex on souring milk

are of significance in the Indian dietary where-in soured milk generally finds a place. Ray has briefly enumerated the year's findings in Animal Nutrition, and Basu has resented a critical summary of the work on Metabolism. In the latter section tapioca is consistently misspelt as *tapioca*.

It is felt that if the entire work on Nutrition had been critically reviewed either by the same reviewer or by the different reviewers in collaboration with each other a more cogent and comprehensive picture of the subject in a single perspective could have been presented.

Study of normal movement of the colon of apparently healthy Indians, Europeans and Anglo-Indians by Moller shows that it is faster in Indians than in Europeans. There was no difference in pulmonary tuberculosis unless there was evidence of involvement of intestines in which case there was hypermotility. Chakravarty has found urea, non-protein nitrogen, chloride and cholesterol in the blood of young adult Bengalis lower than in those of non-Indians and those of people of Bombay province. Using Russell's viper venom as a source of prothromboplastin Rahman and Giri found average prothrombin time for healthy blood to be ten seconds, which was found to be prolonged in tuberculosis, malaria, jaundice and anaemia. It is significant that they found no relationship between plasma prothrombin and serum calcium. The important role of dietary histidine in regeneration of haemoglobin and R.B.C. has been shown by Yeshoda. Repeated multiple pregnancies neither elevate blood pressure nor cause a rise in incidence of toxæmia. The toxic factor in earlier pregnancy is unknown. This is shown by Corary's work among rural women in Ceylon. Even among individuals of the same race blood group distribution is influenced by environmental factors as shown by Mazumdar's work.

Antibacterial properties of two compounds related to merthiolate were studied by Bhattacharya and Gupta. Dharmendra and Mukherjee found sulphapyridine and sulphanilamide lethal to *B. lepræ muris*, *in vitro*, but failed to cure the infected animals. Bose describes a powerful non-toxic antibiotic against Oxford strain of *S. aureus*, *B. typhosus* and *V. cholerae*. He isolated it from the filtrate of the culture of polyporus. Lactones having anthelmintic properties have been prepared by Paranjpe and others. Ahuja and Brooks claim success in their method for estimation of antihæmolytic titre of cobra antivenene. Bose and Ghosh have described an easier and reasonably satisfactory method of assaying adrenaline solutions in guinea-pigs.

The chemical method of assaying anthrocene purgatives evolved by Ghosh and others is claimed to be better than bioassay. Sahasrabudhe has made an interesting observation on α -trogenic activity in lipase obtained from defatted castor seeds. But he does not say whether olive oil, which he used as solvent for lipase, is free from that activity. Bose and Mukerjee have found that the narcotic properties of hemp resin-charas in the alkali-insoluble fractions, whereas soluble fractions were inactive. The alkaloidal content of Indian lobelia is reported to be greater if collected in suitable localities during October-November. The ether extract

alone is of doubtful therapeutic activity. Chopra and others have isolated an alkaloid from *Inula royleana*. Some of the alkaloidal bases of argemone oil, a common adulterant of mustard oil, are suspected to be the possible causative agents of Epidermic dropsy. Ranganathan could not find any correlation between toxicity and solubility of fluorides, because magnesium fluoride which is insoluble in water is more toxic than soluble sodium or calcium fluorides. He has reported the mitigating influence of calcium in experimental fluorosis.

Panja and others have found sweet and sour curds similar in bactericidal action on *V. cholerae*, *B. typhosus* and *B. dysenteræ*. Lactic acid was found to be chiefly responsible for this action. Panja has described an easy method of obtaining a rough variant of *V. cholera* by adding a small fraction of atebirin to the culture medium. Owing to the frequent occurrence of *B. paratyphosus* and *B. enteritidis* infection the advisability of incorporating these organisms in the prophylactic typhoid vaccine is suggested. Menon's observation of the co-existence of *G. Intestinalis* and *Fuso spirochaetes* in some obscure cases of diarrhoea deserves further study. In a critical study of eight cases of "tropical Eosinophilia" it appears that the syndrome is of an infective origin, although some observers consider it an allergic phenomenon. No evidence of toxicity was observed in a series of 24 cases of serum transfusion where nearly 1,000 c.c. of the serum was transferred. Cardiovascular and other changes in a group of fifty cases of diabetes were studied by Chakravarty. A number of modified media for easy identification of intestinal pathogenic organisms have been described by various workers. A useful technique by flotation with copper sulphate solution for concentrating *E. histolytica* cysts has been described. By the incorporation of 200-1,000 units of penicillin in the culture medium, *L. tropica* was isolated from skin cultures free of staphylo and streptococci. The unsuitability of white mice for the study of leptospirosis has been noted by Lahri and Das Gupta. An interesting case of splenic cyst due to malarial enlargement and subsequent atrophy of splenic pulp has been described. Veeraraghavan's finding of a protozoal parasite in the central nervous system of animals suffering from rabies is a revolution in the idea of the etiology of rabies. The method of cultivation of the brain of suspected cases of rabies is described by the author as a surer and quicker method of diagnosis. An effective polyvalent antsnake venom serum useful against all the common snake venoms of India has been prepared by the Haffkine Institute. The serum is available in lyophilised form which can be stored in ordinary condition without affecting the potency for a considerable time. Improvements in the serological test for diagnosis of typhoid fever, Kala-azar, cholera and lyptenhis are described by different authors.

Billimoria and Jacobi have investigated the relationship between tuberculosis and carbohydrate metabolism by sugar tolerance test. A case of tuberculosis lesion of the cranial bone which is rare has been described.

K. S. RANGAPPA.
K. P. MENON.

SCIENCE NOTES AND NEWS

International Geological Congress

The Eighteenth Session of the International Geological Congress, originally planned for 1940 and postponed on the outbreak of war, is to be held in Great Britain in 1948, on the invitation of the Geological Society of London.

Sessional meetings will take place in London from August 25th to September 1st, 1948.

All communications should be addressed to the General Secretaries, Eighteenth Session International Geological Congress, Geological Survey and Museum, Exhibition Road, London, S.W. 7.

Two New Technical Schools for India

The Most Reverend Louis Mathias, Archbishop of Madras, announced in New York on November 15th that the Roman Catholic Church was planning to help India's industrialisation programme by opening two technical schools to train Indian technicians in various engineering fields and allied sciences. He said the schools will cost \$250,000.

Rev. Mathias arrived in America in November to obtain used machinery and other equipment as well as funds for the project. He said the schools, which will be in the City and suburbs of Madras would be open to all faiths "to train the youth of India for the vast responsibilities which are to be theirs in the future".

Indian Institute of Metals

The Indian Institute of Metals will be inaugurated on December 29th at the Royal Asiatic Society's Hall by Dr. Syama Prasad Mookherjee, Minister for Industry and Supply.

The Institute has been founded by leading metallurgists in India with the object of promoting and advancing the study and practice of the science and technology of making, shaping and treating metals and alloys. The Institute has among its members highly qualified metallurgists who have specialised in the various branches of metallurgy.

Sir J. J. Ghandy, Director, Tata Industries, Ltd., has been elected first President of the Institute and will deliver his presidential address at the inaugural meeting.

A Carnegie Grant

The Cornell University has announced the receipt of a 180,000-dollar-grant from the Carnegie Corporation of New York, to investigate the impact of modern agriculture, science and industry on such areas as India, the Far East and Latin America.

The President of the University, Mr. Edmond E. Day, said that the fund will be used in a programme of research and instruction in which anthropologists and other scientists will study contemporary problems.

The findings will be used at Cornell in special training courses to prepare interested American and foreign students for work in these regions.

Scientific Research in U.P.

The Committee appointed by the U.P. Government for the promotion and encouragement of scientific research in universities and elsewhere in the province will be presided over by Dr. K. S. Krishnan, Director, National Physical Laboratory, Government of India. The first sitting of the Committee will be inaugurated by Mr. Sampurnanand, Education Minister.

In setting up this Committee the Government have no intention of interfering with the freedom of research in universities. The Government have provided a sum of Rs. 50,000 in the budget under education for the current financial year for financing researches not conducted by the universities. A sum of one lakh has also been provided in the budget for the current year for giving assistance to universities towards conducting research in science.

Applied research will be undertaken at the Committee's own initiative or at the instance of private individuals or firms. In the latter case the party concerned will be required to make such contributions as the Committee may consider necessary.

Telephone Manufacture

Plans for setting up a new telephone plant factory in India are reported to be complete by the Government of India. The new factory is likely to be established in Bombay where a factory for the manufacture of telephone apparatus and parts already exists. The new plant-manufacturing factory is intended to meet the increasing needs of the automatic telephone system which the Government of India propose to introduce throughout the country.

The project is expected to cost the Central Exchequer seven crores of rupees and is likely to be completed in three years' time.

Intermediate for Dyes and Developers

2, 4-Diaminophenol obtained by the reduction of *m*-dinitrobenzene, a valuable intermediate required for photographic developers of the 'Amidol', 'Diamol' and 'Dolmi' class, and of dyes employed in the dyeing of furs and hair, has been prepared in good yields in the laboratories of the Presidency College, Madras, by the electrolytic reduction of *m*-dinitrobenzene in sulphuric acid emulsion using a copper or monel cathode and a lead anode in the presence of mercuric and ceric sulphates. In simplicity and economy of operation and low upkeep charges, the process is reported to be superior to other processes.

Vegetable Oil for Diesel Fuel

Investigations carried out under the auspices of the Council of Scientific and Industrial Research have shown that most of the Indian vegetable oils can be successfully employed as Diesel fuels. Cotton seed oil, in particular, gives exceptional performance in that its consumption is definitely less than that of mineral oils. Despite their good performance, however, vegetable oils cannot compete with mineral fuels because of the high price. If vegetable oil could be used as a vehicle for powdered solid fuel, the resulting fuel will be cheaper than the oil and may be able to compete with the mineral oil. This possibility has been tested in the laboratories of the Council. The results show that with the use of a stabilizer prepared from the oil itself, colloidal fuels containing as much as 35% by weight of charcoal can be prepared and stored for lengthy periods without the charcoal settling down. Provided the injection system is replaced to suit the new fuel, a thermal efficiency approaching that of groundnut oil can be attained, the charcoal part being burnt as efficiently as oil itself. For this to be possible the charcoal should be reduced in size to about 2μ and the injection system should be redesigned.

Important Mineral Finds in Mysore

Applying the geophysical techniques, the Geology Department in Mysore has discovered a promising pyritiferous ore body at a depth of 80' below the surface at Guddarangavvanahalli and another in Ingaldhal, both in the Chitaldrug district. The latter is estimated to yield about half a million tons of pyritic material with a sulphur content varying from 25 to 42 per cent. in an area of about 100 acres so far surveyed. The ore can be utilized for the manufacture of sulphuric acid.

A large body of graphite schists estimated to yield 50,000 tons of the ore at a depth of 10-15 feet below the surface and suitable for pencil making, lubricants, paints, foundry facings and electrodes, has also been discovered.

Indian Forest Ranger College

The Report for the year 1945-46, of the Indian Forest Ranger College, Dehra Dun, which has been published after a lapse of four years, shows that the College expanded by fifty per cent. during the year, to meet the demand for trained Forest Rangers.

The two-year course at the College includes teaching of Silviculture, Forest Protection, Forest Management, Forest Mensuration, Forest Utilisation, Forest Law and the allied subjects such as Forest Botany, Forest Pathology and Mycology, Forest Entomology, Forest Engineering, Geology, Soil Science and Forest Surveying. In addition, extensive tours are made to forests in many Provinces to impart practical training.

Award of Doctorate

The D.Sc. Degree of the Andhra University has been awarded to Mr. J. Venkateswarlu for his thesis on "The Morphology of *Martiflorae* with Some Observations on the *Nyctaginaceae*."

Mr. P. Venkateswarlu, M.Sc., has been awarded the D.Sc. of the Benares Hindu University for his thesis on "Molecular Spectra of the Halogens".

World Committee on Malaria

Dr. D. K. Viswanathan, Assistant Director of Public Health, Malaria, Bombay Province, has been appointed by the Government of India to be a member of the Expert Malaria Committee of the Interim Commission of the World Health Organisation.

Dr. Viswanathan will visit the U.S.A. in the near future, to attend the meeting of the expert Malaria Committee in Washington in May 1948, and to study the methods of health publicity followed in that country. He is also being deputed by the Government of Bombay to the Congress of Tropical Medicine.

A New Pest of Jute

Ferrisia virgata CKII (Coccidae), a fairly common mealy bug in India, has recently been recorded as a pest of jute (*C. olitorius*), particularly on these plants which were under selfing covers for experimental purpose in the Dacca farm of the Indian Central Jute Committee. The damage is mostly caused by the nymphs which usually remain congregated around the mother and suck up the sap of the stems, pods, petioles and leaves. The female has a pair of long white caudal filaments, her whole body covered with white powdery meal and cottony hairs, and can lay as many as one thousand eggs in course of two or three days after which she dies.

Foam for Fighting Fires

Large petrol fires cannot be fought with the usual fireman's water jet, because the petrol floats on the water and continues to burn. Foam is lighter than petrol and it can form a blanket on top of the petrol and so extinguish the flames. The type of foam largely used in Britain is called mechanical foam; it is produced by churning up air and water with a foam stabilising agent.

The most suitable agents are chemical breakdown products of hoof and horn meal, or glue mixed with materials similar to soapless shampoos or chemically treated blood. The latter is a waste material from abattoirs.

The new foam compound is said to have the additional advantage of a much lower viscosity than other types and so it could be used without modification in R.A.F. crash tenders. It produces a high efficiency foam for combating aircraft fires.

Details of the researches on fighting petrol fires with foam are published in *Chemical Research Special Report, No. 6.—A Study of Mechanically Produced Foam for Combating Petrol Fires* (H. M. Stationery Office, London).

A Photoelectric Hygrometer

An instrument that measures small absolute humidity changes by the photoelectric examination of the 9,400 Angstrom units absorption

band of water vapour is described in the *Bulletin of American Meteorological Society* (September 1947). The instrument consists of a small source of light which sends its radiation over an air path of less than one and a half metres to a dispersing system. The resulting spectrum then is allowed to fall on two vacuum phototubes; one centered in the 9,400 Angstrom units absorption band of water vapour, the other located at 8,000 Angstrom units where no water vapour absorption bands exist. As the absolute humidity in the air path is varied, the phototube in the region of the band is affected; whereas the reference phototube is not. The phototubes are arranged in an amplifying circuit so as to magnify the effect of varying humidity. The instrument uses a portable microammeter instead of the sensitive galvanometer of all previous spectral hygrometers. Humidity changes of 2 to 8×10^{-5} centimetre of precipitable water-path over 143 centimetres of air path can be measured. An investigation of the small sensitive range of the instrument was carried out and the results indicate that the device is confined to use over a small humidity range with equipment available at the present time.

Diet and Tumour Growth

Experiments on the incidence of cancer and other neoplasms show that caloric restriction of the diet inhibits the genesis of all types of mouse tumours that have been studied, namely, induced skin tumours and sarcomas, spontaneous mammary carcinomas, lung adenomas, hepatomas, and spontaneous and induced leukemia. Fewer mice develop tumours, and these appear at a later time on restricted caloric intake. It is thought probable that the main influence occurs during the development of the tumour rather than during the preparatory stage.

Among human beings, analysis of mortality records of insured persons reveals that individuals who are overweight when past middle age are more likely to die of cancer than are persons of average weight or less. Coupling these results with those obtained with mice, it is concluded that the avoidance of overweight might result in the prevention or at least delay in the incidence, of a considerable number of cancers in human beings.

Cystine and choline in the diet have also been found to influence tumour growth. While a diet restricted in cystine reduced the incidence of leukemia, choline-deficient diet caused neoplasms.

—(New York Acad. Sci., Vol. 49.)

Locating Cable Faults

Early and precise location of a fault in a cable is an essential factor in any efficient telegraph or telephone system. Britain's Post Office radio engineers working on the problem have developed a fault-locator which is based on the same principles as those applied in radar.

This new fault-finder, known as a pulse locator, comprises a cathode-ray tube detector, and it transmits a high frequency pulse over

a cable. The pulse is reflected back from any obstruction due to a fault. The time taken by the pulse to travel to and from the fault is measured on an oscilloscope. From this is calculated the distance to the fault.

This pulse locator is outstanding for the clarity and reliability of its indications, particularly when more than one fault is present. Faults on co-axial cables which contain co-axial tubes, each pair of which can carry several hundred simultaneous conversations, can be located within one per cent. of their true distances at ranges up to ten miles.

Publications Received

The Indian Sugar Industry (1946-47 Annual), Vol. XII, November 1947. Rs. 6. Editor M. P. Gandhi.

Indian Forest Records (New Series), Utilisation, Vol. 4, No. 1, 1946. (Published by the Forest Research Institute, Dehra Dun.) Price As. 5.

Indian Forest Records (New Series), Vol. 3, No. 7, 1945. (Published by the Forest Research Institute, Dehra Dun, U.P.). Price Rs. 5-12.

The Role of Glaciers and Snow on Hydrology of Punjab Rivers. By Kanwar Sain. (Published by the Central Board of Irrigation, Simla.)

Proceedings of the Royal Physiographic Society at Lund, Band 16, 1946.

Report of the Industrial Delegation. (A.I.M.O., Bombay), 1947.

ERRATA

Vol. 16, No. 11, November 1947, p. 343, Note on "The Colouring Matter of *H. esculantus*": Column 1, para 1, last sentence: Delete "One of the varieties of" and begin the sentence with "The".

Para 2, line 17: Read "230-32" for "230-320 °C."

Column 2, para 1, line 8: Read "yellow-green-blue" for "yellow green blue".

Para 2, line 1: Read "was" for "is".

Vol. 16 Page	Subject	Portion	Para Line	
130	"Abnormally dry etc"	Left	1 5	read well-distributed for well-disturbed
	"	Right	1 16	read of for or
174	"Air mass etc."	Left	1 8	read moist layer for moist
175	"	Right	5 16	read air can be made easily unstable for air is unstable
245	"Abnormally heavy rainfall etc."	Left	1 26	read a satisfactory theory for data
	"	Right	3 4	read comes for come
247	"	Right	1 12	read strong winds only below 1.5 to 2.0 kms. even on a good monsoon day for such variations

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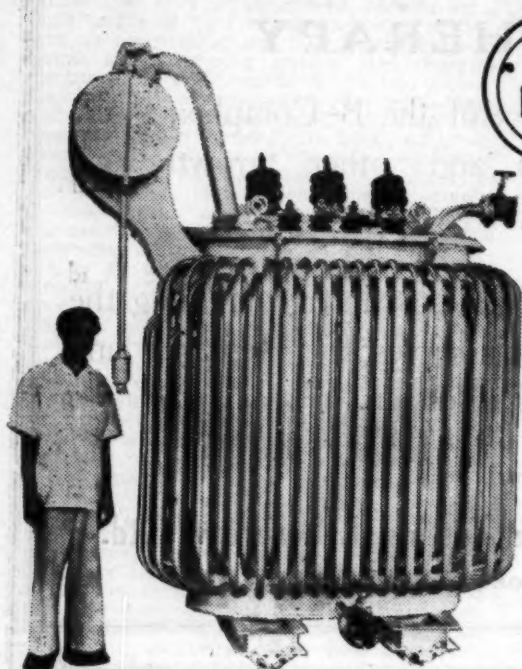
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The selected candidates will be on probation for a period of two years, after which, if confirmed, they will continue till the 30th June following the date of their attaining the age of 55. They will join the Provident Fund Scheme of the Institute, the rate of subscription being 8½% of their salaries, the Institute contributing an equal amount. Leave and other privileges will be governed by the Regulations and By-laws of the Institute for the time being in force. Six copies of applications together with six copies of all testimonials and two sets of published papers, if any (which will not be returned), should reach the undersigned on or before 10th January 1948.

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A science degree and association or participation in research work in any branch of Electrical Engineering will be desirable additional qualifications.

The selected candidate will be on probation for a period of two years after which, if confirmed, he shall continue till the 30th June following the date of his attaining the age of 55 years. He shall join the Provident Fund Scheme of the Institute, the rate of subscription being 8½% of his salary, the Institute contributing an equal amount. Leave and other privileges will be as determined by the Rules, Regulations and By-laws of the Institute for the time being in force.

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Flask Capacity	250 c.c.	500 c.c.	1000 c.c.	2000 c.c.	3000 c.c.	5000 c.c.	10000
Indian	1/2	1/10	2/15	5	10/12	18/8	
English	2/10	4/8	5/14	9/8	14/8	23	38/8

Measuring Cylinder	100 c.c.	250 c.c.	500 c.c.	1000 c.c.	2000 c.c.	
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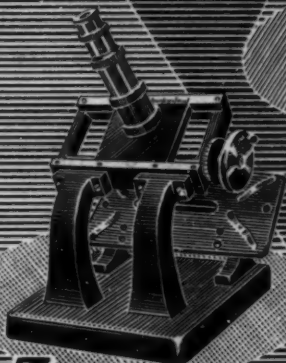
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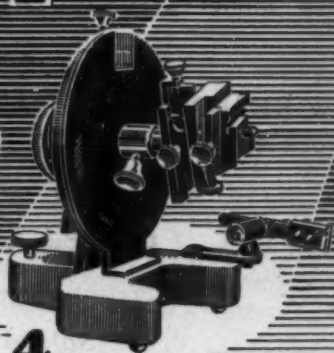
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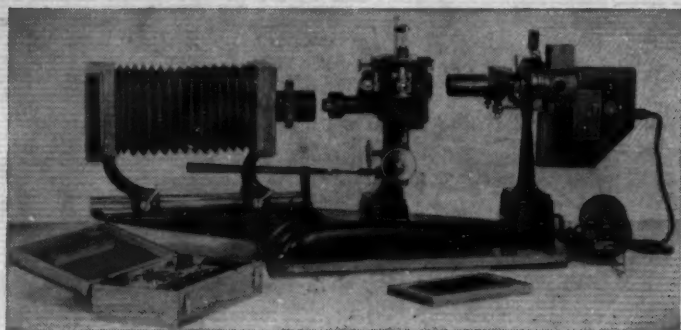
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